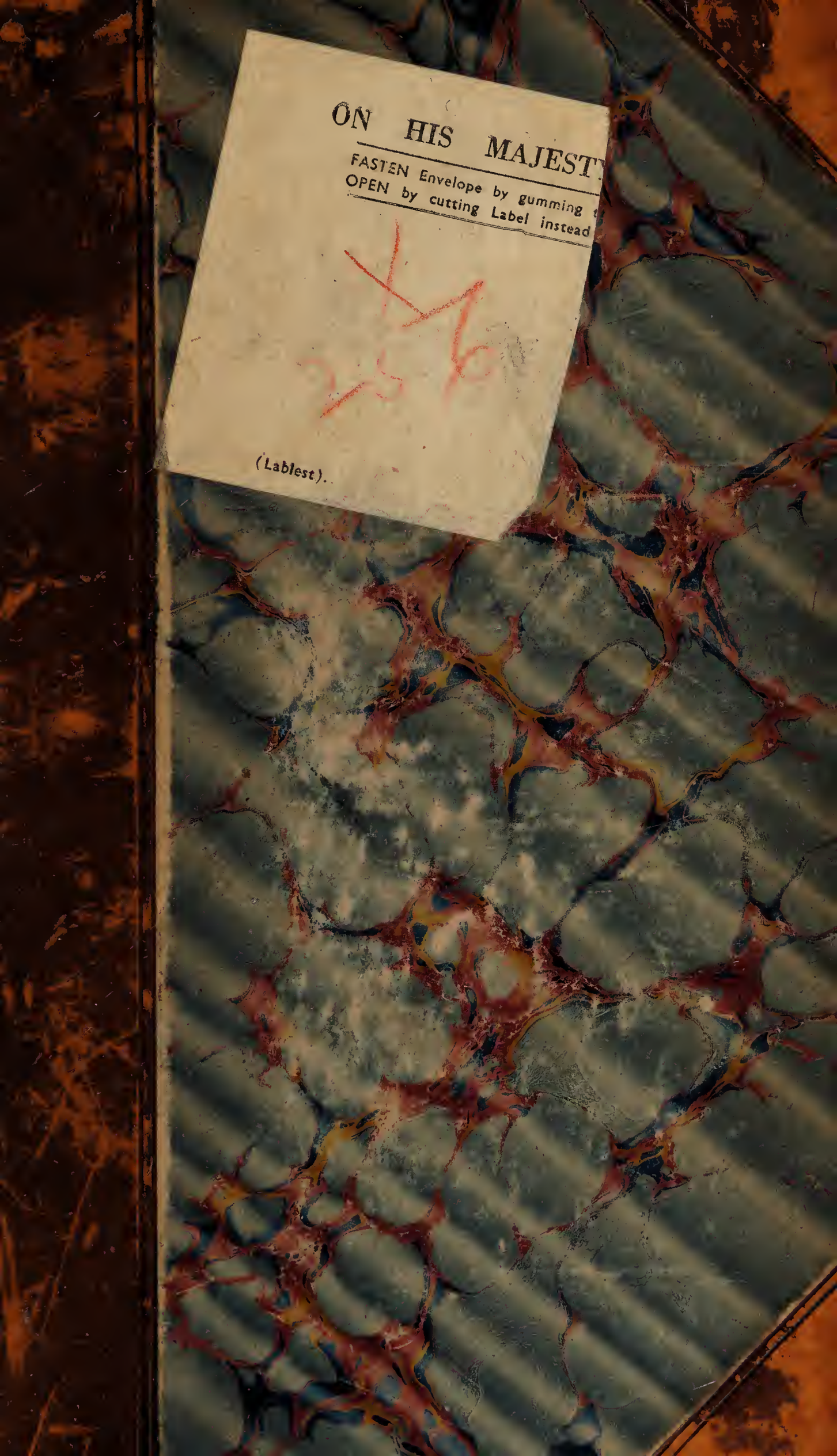
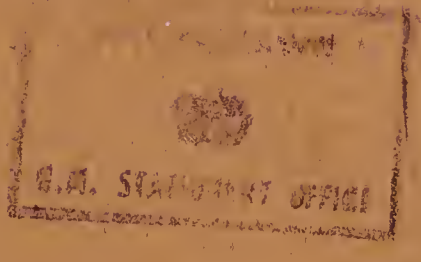

ON HIS MAJEST
FASTEN Envelope by gumming
OPEN by cutting Label instead
(Lablest).

176
Bay H3



Digitized by the Internet Archive
in 2019 with funding from
Wellcome Library

https://archive.org/details/s23id13277750

HIGHGATE
LITERARY & SCIENTIFIC
INSTITUTION

ARCHIVES & REVIEW

OF

UNIVERSAL SCIENCE.

ARCHIVES

OF

UNIVERSAL SCIENCE.

CONDUCTED

By ALEXANDER WALKER, Esq.

LECTURER ON PHYSIOLOGY, ETC.

The less *extensive* our data are, the less *perfect* must our inductions be. Hence, the cultivation of the various portions of science, merely in a separate manner, must hitherto have retarded its progress; and it is only by the study of all its departments, that we can most effectually cultivate each, or by a knowledge of Universal Science, that we can possibly excel in individual ones.

ANON.

VOL. III.

(JULY, 1809.)

EDINBURGH:

PRINTED BY C. STEWART,

FOR SHERWOOD, NEELY AND JONES, PATERNOSTER-ROW,

LONDON, AND

T. BRYCE AND CO. INFIRMARY-STREET,

EDINBURGH.

1809.

HIGHGATE
Literary & Scientific
INSTITUTION
312768

PATENT OFFICE
LIBRARY

ADVERTISEMENT.

27.9.10
Presd

As the best pledge the Editor can give of the labour which, for many years, he has bestowed upon the various departments of science, and of his ability to conduct the work which he has undertaken, he has still *thought it his duty to present to his readers a paper on an important subject in each of these departments. These papers he has substituted for the "Outline of a Natural Theory and System of Universal Science," which he had previously proposed to give in this volume, because he thought it would be proper to discuss the most important particular subjects of science, before he took a general view of the whole.*

He deeply regrets that the labour which some of these subjects required (the anatomical papers especially, for which he was under the necessity of dissecting not less than a hundred encephala*), have greatly delayed the present volume; but he does trust that the public will deem the value of the papers a compensation for the delay.*

The great length of these papers has necessarily excluded much of the Third Part—the Reviews, which,

even in this volume, it was the Editor's intention to have added to the work. The public, however, will not be dissatisfied with this, when it understands that the present volume already exceeds, by about a third, the number of sheets (18) promised in the Prospectus. The reviews, also, intended for the volume, are ready, and, together with others of equal importance, will appear in the next one, now in the press.

In this present volume, however, a review of a work on a subject of the utmost general interest has been given, as a specimen of the manner in which that department of the work will regularly be conducted in all the subsequent volumes. It is not perhaps written in the manner of these productions in any Review of the empire; as, while it exhibits not less of patriotism than any of them, its principles and sentiments are equally remote from the phrenzy of jacobinism, and from the imbecillity of unqualified aristocracy. *The Editor is satisfied, that it should be strictly considered as a specimen both of the principles and of the manner of the reviews in all the subsequent volumes; and he trusts he may claim the confidence of his countrymen in this respect, on the ground that his pledges with regard to the scientific part of the work have not hitherto been forfeited, but that it has, in all the departments of science, been eminently improved. It shall not be less so with regard to the Reviews.* While, on the one hand, its patriotism shall remain unquestionable, even by the most insidious, and while, on the other, it wages war with jacobinism and revolutions, it shall not be marked by that timid and jesuitical spirit which, in North Britain, too generally characterises those who pretend to be the friends, and

who prosper by being the pretended, though utterly ineffective, friends of constitutional principles; *but who, having neither science nor active energy, cannot be of use in any cause—who, having no confidence, cannot inspire confidence in others—who, being really mean and time-serving, bring all causes into contempt. The temperate use of that freedom of discussion which is the birthright and the boast of every Briton; the absence of whatever approaches to the spirit of party; the love of salutary and temperate reform; and the inculcation of those principles which, in the present awful crisis of European affairs, can alone lead to the salvation of the empire, will, the Editor is convinced, obtain for the political portion of the Review the serious attention of his countrymen.* The Editor will neither, with one party, be the friend of political imbecillity—of a neglect in internal affairs, and of incapacity in planning foreign expeditions; nor, with a more constitutional one, will he be the advocate of an abandonment of all the external relations of the empire; *for he considers nations to be to each other on a great scale, that which the individuals of a family are to each other on a smaller; the closest relations subsist between them, and the abandonment of reciprocal interest would be madness. These relations, too, he is convinced, have been neglected by that party, solely because their previous management by weak persons excited an unreasonable despair. The difficulties were not in the cause, but in the political ignorance of those to whom it was entrusted.*

To Dr Roberton and Dr Hamilton, for their very valuable communications to the present volume, the Editor is under the greatest obligations. By the communications in the Arts, he is also greatly obliged. Those,

however, of Mr Fraser, of St David's Street, and of Mr Allan, of Greenside Place, were too late for insertion in the present volume; but their value will entitle them to a place in the subsequent one. Communications, such as these last mentioned gentlemens', from artists and mechanics of every description, will be most gratefully received. It is one of the great objects of the work to give the utmost encouragement to the improvers of all the useful arts.

Hope Park House, Edinburgh.

PATENT OFFICE LIBRARY.

CONTENTS OF THIS VOLUME.

HIGHGATE LITERARY & SCIENTIFIC INSTITUTION

PART I. SCIENCES.

METAPHYSICS.

PAGE

General View of Metaphysical Science. *By the Editor*.....1

GENERAL PHYSICS.

On the New Planets. *By Dr Gauss*.....22
New Constellation.....24
Remarks on some points of Hydrography. *By M. Leblanc*.....24
Observation of a Lunar Rainbow. *By M. Cordier*.....26
Fall of Meteorolites.....26
General Hypothesis in General Physical Science, and in some portion of Particular Physics. *By the Editor*.....27

PARTICULAR PHYSICS.

On the Existence of Oxygen in Ammonia. *By Dr Henry*.....78
On the Action of Potassium on Ammonia. *By H. Davy, Esq*.....79
Discovery of a New Metal. *By Dr Jahn*.....79
Of another New Metal.....80
Of Identity of Columbium and Tantalium. *By Dr Wollaston*.....80
Of the Spontaneous Ignition of Charcoal. *By M. Sage*.....80
Theory of the Detonation and Explosion of Gunpowder. *By the same*.....82
On the Igneous Fusion of Barytes. *By M. Geblen*.....83
On the Existence of Oxygen in Prussic Acid. *By Mr Porret*.....84
Account of the Decomposition and Recomposition of Boracic Acid. *By M. M. Lusac and Thenard*.....85
On the Influence of Galvanic Electricity on Minerals. *By M. Guyton*.....88
On Artificial Sand stones. *By M. Alluau*.....92
On Oxygenized Muriatic Acid. By *M. Mojon*.....96
On Suberic Acid. *By M. Chevreul*.....98
On the Chemical Nature of Smut in Wheat. *By M. M. Fourcroy and Vauquelin*.....102
On the Alteration of Flesh by Air and Water. *By M. Berthollet*.....105
Chemical Miscellanies. *By Professor Link*.....107
On the Origin and Formation of Roots. *By T. A. Knight, Esq*.....108
Of Nectarines and Peaches on the same Branch. *By R. A. Salisbury, Esq*....113
Of Sugar from the Rosebay.....115
Of a New Species of Mouse. *By M. Ljung*.....116
Of a New Quadruped. *By M. Lacepede*.....116
Of a peculiar Claw in the Beaver. *By M. Costaing*.....117
Of a Canal in Medulla Spinalis of Quadrupeds. *By Mr Sewel*.....117
Critique on the Report of M. M. Tenon, Portal, Sabatier, Pinel and Cuvier on the Memoir of Drs Gall and Spurzheim relative to the Anatomy of the Brain, in which the greater number of the pretended Anatomical Dis-

PAGE

coveries both of these German and French philosophers are subverted, and their Physiological ones refuted. *By the Editor*.....119
New Anatomy and Physiology of the Brain. *By the Editor*.....172
On the Azote disengaged by Respiration. *By M. M. Pepys and Allen*.....180
On the relative Influence of Parents on Offspring. *By T. A. Knight, Esq*....180
Miscellanies in Physical Science. *By the French National Institute*.....181

LITERATURE.

Sketch of a Theory of Natural and Universal Language. *By the Editor*.....188
Principle of Composition, enunciated and illustrated in the preceding volumes, applied to the Greek Language and to Poetical Composition. *By the Editor*.....212
A Critique on the Antique Statues and those of Michael Angelo, in which not only the defects in their attitudes, but also the errors which they present with regard to the particular muscles brought into action, are pointed out. *By the Editor*.....224

MORALS.

Critical Analysis of the Moral System of Mr Godwin. *By the Editor*.....233

POLITICS.

Advertisement.....270
History of the Period, with Political Reflexions. *By the Editor*.....271

PART II. ARTS.

MATHEMATICAL ARTS.

New Method of Dividing Mathematical Instruments. *By Mr Cavendish*.....329
On the Fibres used in Micrometers. *By Dr Brewster*.....330
New Goniometrical Telescope and Microscope. *By Dr Brewster*.....331
On Barometrical Measurements.....331
Description of a Gauge for Standing Timber. *By Mr J. Broad*.....336

MECHANICAL ARTS.

Improvement in Jury Masts. *By Captain W. Bolton*.....338
Improvement in Anchors. *By Captain H. L. Ball*.....340
Improvement on the Telegraph. *By Major C. Le Hardy*.....342
Method of Raising Large Stones out of the Earth. *By Mr R. Richardson*.....345
Invention of Artificial Wings. *By M. Degen*.....347
Machine for Travelling under Water. *By Baron Lutgendorf*.....348
Plan for Preventing or Suppressing Fires.....348

CHEMICAL ARTS.

On Constructing a Voltaic Apparatus. *By J. G. Children, Esq*.....350
Description of an Apparatus for making Carbonated Hydrogen Gas from Coal, for lighting Factories. *By Mr S. Clegg*.....354

PAGE
Analysis of James's Powder. *By M. Pully*.....357
On the Purification of Camphor by Potash.....359
New Method of Detecting Arsenic. *By J. Hume, Esq*.....359
Observations on Sulphuric Ether. *By M. Boullay*.....359
On the Conversion of Malt Spirit into Vinegar, and on the Red Colour of Oil of Hempseed. *By M. Resal*.....362
Mode of Recovering Sour Wine. *By M. Creve*.....363
On Painting Linnen Cloth in Oil Colours. *By Mr W. Anderson*.....363
On the Fabrication of Artificial Stone. *By M. Bertrand*.....368
New Process for Hardening the Surface of Plaister Casts.....369

AGRICULTURE, GARDENING, &c.

On Reclaiming Waste Lands. *By Mr Wagstaffe*.....369
Account of Waste Lands Improved. *By J. Butler, Esq*.....372
On the Fertilizing Properties of Ammonia in Manures. *By Mr. W. Cox*.....375
On the Advantages of Using Oxen and Neat Cattle in Husbandry. *By Lord Somerville*.....378
Practical Statement on the same Subject. *By J. Billingsley, Esq*.....382
Chinese Method of Propagating Fruit Trees. *By Dr. J. Howison*.....385
On the Cultivation of Flax. *By Mr J. Dunbar*.....388
On the Cultivation of the American Cranberry. *By the Right Hon. Sir Joseph Banks*.....390
Method of Preserving Fruit without Sugar. *By Mr T. Saddington*.....392
On the most profitable sort of Sheep. *By a Committee of the Bath and West of England Society*.....396
On an Insect which destroys Wheat. *By J. Walford Esq. and T. Marsham Esq.*.. 398

MEDICAL ART.

Observations on the Natural System of Medical Science proposed by the Editor. *By Dr John Hamilton*.....402
Answer to the preceding Communication. *By the Editor*.....404
View of a more rational Pathological Theory and Practical Treatment in Gleet, Leucorrhæa, Seminal Emission and similar affections of the Generative System. *By Dr Roberton*.....406
Observations on the Treatment of Hydrocephalus. *By Dr Roberton*.....414
On the most Advantageous Mode of Prosecuting Medical Studies. *By the Editor*.....416

PART III. REVIEW.

SPECIMEN.

Considerations on the Causes, Objects and Consequences of the present War, Reviewed by W. Roscoe, Esq ; and a Letter to Mr Roscoe on that Publication. Reviewed *by the Editor*.....423

List of New Publications.....440

ERRATA.

In line 35 of page 15, for *Arithmetic*, read *Geométry*.

In line 10 of page 24, for *Bounaparte*, read *Buonaparte*.

In line 11 of page 24, for *Numbers*, read *Members*.

For various other Errata which the general sense of the passages in which they exist, renders obvious, the indulgence of the reader is claimed.

N. B. *The plates not being yet ready for insertion in the volume, it has not been thought proper longer to delay the work on their account. They will, however, be given with the next volume now in the Press; or they may be had separately, in a few days, from the Bookseller.*

PATENT OFFICE LIBRARY

ARCHIVES

OF

UNIVERSAL SCIENCE.

HIGHGATE LITERARY & SCIENTIFIC INSTITUTION

(JULY 1809.)

27.9.10

PART I. SCIENCES.

FIRST DEPARTMENT OF SCIENCE, OR METAPHYSICS.

General View of Metaphysical Science.

BY THE EDITOR.

I. DIVISION. DEFINITION OF THE SCIENCE, &c.

AS in some papers delivered in the previous volume, I have refuted several of the most celebrated hypotheses, and discussed several of the most difficult questions in metaphysics, and as that science appears to me to have consequently assumed an infinitely simpler form, it may not be improper now to consider the whole of this subject as free from objection, to view the relations which subsist between its parts, the order in which they naturally stand, and the manner in which one of them is evolved from another.

Here it will appear remarkable that this relationship, this order, and this evolution are themselves so intimately connected, that the same process of observation and reasoning renders them at once apparent. Thus the simplicity of the view considered even alone will afford a presumptive proof of its truth.

It will appear, that, from one or two fundamental circumstances, and these in themselves perfectly simple, the whole of the complex considerations of metaphysical science arise.

It is improper to define Metaphysics to be "the science of the principles and causes of all things existing;" because it would thus be 'universal science' and not an individual portion of it. Indeed I know of nothing in the whole range of science which this definition would not involve. By Aristotle, it was much more correctly termed the "first philosophy"; because it is prior in the order of nature to all the other sciences and arts. The term itself, however, is incorrect; for all the subjects of which it treats, whatever may be their priority, far from being μετα τα φυσικα, are, as I shall show, obviously and strictly physical.

Even from its origin, then, this term has been a mere apology for ignorance—a mystical name under which superficial persons have artfully thrown all those subjects the precise physical nature of which they were incapable of ascertaining. Thus, as at present constituted, it actually consists of the more difficult portions of several sciences...Not contented with its considering the nature of matter, motion, &c. philosophers bring under it a subject with which that has no direct connection—a subject which is *toto cælo* different, and the arbitrary connexion of which with the former has been productive only of obscurity and perplexity to both: I mean the philosophy of mind or, more correctly, of the functions of the intellectual organs—the most interesting and the most difficult branch of physiology. This subject they have held to be μετα τα φυσικα exactly because they knew little either of these functions or of the organs which performed them. Not contented, however, even with this step toward the fettering of reason, and the annihilation of thought, as they felt it necessary not only to hide their ignorance, but to prevent its detection, they had the meanness and the art to drag into their cause the aid of religion and even of superstition; they misapplied the former, and wrested even the latter; they called upon the world to accuse of impiety all who should deny their dogmas by daring to imagine that the operations of the mind are not μετα τα φυσικα, but strictly physical, and among the least mysterious and most easily accessible subjects of human inquiry—in short that the sublimest works of nature or of God are not necessarily connected with mystery, and that the deity is most highly honoured by the production of these effects by the simplest physical means.

I freely confess that I, for one, deride their obloquy and contemn its dangers.—I am of opinion that all the operations of mind (not *soul*) are physical—that they are the functions of the intellectual organs of the human body. (The foundation of this opinion I have established in the paper on the intellectual functions in the last volume of this work, and need not now repeat it.) I, therefore, cannot consider the philosophy of the mind as a branch of metaphysical science.

Metaphysics, I define to be, "the consideration of all those facts and theories relative to matter and motion which do not involve particular substances".

That matter is quite independant of mind, I have already shown* ; and that, under the metaphysical subjects of number and form, falls the consideration of their respective sciences Arithmetic and Geometry, or of mathematical science in general, I have also pointed out†. It is under these views, therefore, that I proceed to consider Metaphysical Science.

II. DIVISION. OF THE EXISTENCE AND SIMPLICITY OF MATTER.

The first consideration in science refers to matter, and the first question concerning matter relates to its absolute or or real existence.

The single fact of the same objects appearing in the same place to any one, proves that there exists something—a cause or, at least, a basis for sensation. This basis, I denominate MATTER ; and, as by this term, I presuppose only the present definition, and no quality, it cannot be objected to.

Now, there must exist either one matter ; or various kinds of matter.

If there exist but one matter (which even at first seems probable, because it is wrong to suppose more causes than are sufficient to produce effects)—if there exist but one matter, this matter must be either active or passive with regard to the organs of sense—it must either be differently affected by, or it must differently affect them.

* Refutation of Berkeley in Vol. 1. of Archives.

† The definition which I have given of Metaphysics unavoidably involves these important branches of science, for which indeed it is impossible to find another place in natural arrangement. From an impression of this kind, the french philosophers, in the denomination of the first class of their institute, viz. the 'Class of the Mathematical and Physical sciences' have rightly placed the term 'Mathematical' before the term 'Physical.'

Now, in supposing matter to be differently affected by organs of sense, it would be necessary to advance some one proof of this, and, as the same cause cannot produce opposite effects, it would likewise be necessary to explain by what means the organs of sense may produce any tangible or any visible number or form, when at the same time such a number or form have no absolute existence.—If, as is indeed the case, no such proof can be advanced or explanation given, then the assertion is unfounded.

If then, as is, even at first sight, most probable, matter differently affects the organs of sense; as the same cause cannot produce opposite effects, by what means can this one matter produce any thing tangible or visible? Now, there exist no means of effecting this, but peculiar qualities; and, in order that these qualities may affect sensitive organs, they must be cognizable to them. These qualities, then, affect, and are cognizable to the organs of sense.—But these qualities cannot first produce, and then become sensations or the creatures of sensation—they cannot thus possibly be at once a cause, and afterwards the result of the same cause; for that would be contradictory and absurd. Yet this absurdity, if the preceding train of reasoning be correct, the systems of Idealism in general and of Berkeley in particular must embrace.

Matter, therefore, and its peculiar qualities must exist independantly of sensation.

If, on the other hand, it were asserted that there exist numerous kinds of matter, and, if qualities were thus inadmissible, these kinds of matter, in order to admit all the variety of effects on sensitive organs, must be as numerous as the supposed qualities: matters and qualities, then, would in this case become effectually synonymous, and the above reasoning would be equally applicable to both suppositions.

The simplicity of nature, however,—the fact that she never does operate by more causes than are sufficient to produce effects, would, on the slightest consideration, lead us to reject the latter of these suppositions, and the additional fact of the mutation of mineral into vegetable, and vegetable into animal matter, forces us to adopt the former.

This was the opinion of the ancient Greek Philosophers. In ascribing, however, to the πρωτη υλη or primary matter not only universal capacity, but also universal privation, they gave it an incorrect and paradoxical appearance. Their whole error lay in not observing, that though, consistently with the above views, matter always did possess universal capacity, and was never limited to any individual form, yet it always exist-

ed under some particular form, and never possessed universal privation.

III. DIVISION. OF SOLIDITY AND EXTENSION.

Solidity and Extension are the first properties of Matter.

SOLIDITY expresses the intimate connexion that subsists between the minutest particles of matter which we can discover.

EXTENSION expresses the distance which always exists between the extremities of these minutest parts.

IV. DIVISION. OF SPACE

The consideration of matter and its two chief properties naturally leads directly to the consideration of space.

SPACE is either the absence of matter, or the distance between its portions or between objects. The former is properly called a vacuum, the latter properly distance.

From this definition it will appear to be incorrect to say that space has properties, penetrability for instance; because it is absurd to talk of penetrating nothing. It is also improper to ascribe to space necessary existence, immobility, infinity, or eternity, since it is the absence of matter—since it is nothing, and can have no properties. For the same reason, it is improper to say that space has a capacity to receive matter; for even the term 'to receive' is an active verb, and space is nothing in actuality. Matter may have a capacity of existing wherever other matter does not exist—in the distance between bodies—in space, but space or nothing, as already stated, can have no properties—no capacity, and it is an abuse of language to ascribe any to it.

Thus it appears that space is no principle in nature, as Democritus and Epicurus asserted, nor is it, as both they and all the moderns have said, necessary to the existence of any thing: it, on the contrary, *results* from the existence of every two or more objects. Those, therefore, who thus reckon space an actual thing, opposed to matter, might as well, in opposition to motion, light, sound, or body, reckon rest, darkness, silence, absence or nothing to be actually something.

Locke's notion of space was far from being accurate; for he divided it into solid and empty. In his 13th chapter,* however, he more accurately says 'it is the distance between any

* Of the work on the Human Understanding.

two bodies;' but still he seems to think it a real object, speaks of its modifications, and suspects it to be something distinct from either body or spirit. In the 17th chapter, he even calls it infinite, and, in sect. 20th, denies matter to be necessary to its existence. Of this the error is so palpable as scarcely to require a remark.

Dr. Clarke, in his reveries, called space a mode of the self existing substance, which, he said, was not in space nor penetrated by it, but was its substratum or ground of existence. All other substances, he thought, were in space and penetrated by it. This hypothesis is almost too wild to be worthy of notice. When he further says that 'the supposal of the existence of any thing whatever necessarily includes a presupposition of the existence of space*' he speaks with equal incorrectness; because space cannot be said to exist till more than one body has existed. For between man, for instance, and a contiguous object, there is space in only one direction: several objects must exist before space can exist in more.

Bishop Berkeley asserts that pure space 'is the possibility of motion without resistance.' Consistently with his system, the definition was ingenious, but it is founded upon, and falls with, the hypothesis of the nonexistence of matter. It is obvious besides, that, though we cannot conceive motion without space, yet we can easily conceive space without motion—with rest;—a circumstance which Berkeley must have entirely overlooked.

It is also absurd to term space 'the possible existence of body.†' These two considerations are quite different. The idea of space is evidently much more simple than that of the possibility of the existence of body. In reality space—the absence of body is a binary ideal compound, whereas 'the possible existence of body' (which in order to analyse we must resolve into 'the possibility of the existence of body') is evidently a ternary ideal compound. Besides 'space' is ascertained by the exercise of our senses, whereas 'the possibility of the existence of body' is entirely an affair of reflexion.

Kirwan‡ says 'space is the relation of two or more distant bodies to each other, or of the distant parts of the same body to each other.' He thus rightly makes it dependant on bodies; but improperly terms it 'the relation of them.' Bodies may be related in extent, weight, hardness and in many

* 'Demonstrations of the Being and Attributes of God,' and 'Correspondence with a Gentleman in Gloucestershire.' *Passim.*

† Article Metaphysics in Encyc. Brit.

‡ Metaphysical Essays.

other respects, and Mr. Kirwan surely did not mean to refer to any of these. But as Mr. Kirwan uses the term '*distant* bodies,' he probably means that 'space is the relation of two or more bodies with regard to their distance' thereby specifying a particular relation; and indeed this is the only meaning that one can suppose him to have had. But the error even here is egregious. Mr Kirwan forgets that relations can subsist only between different things; whereas the distance of two bodies from each other is one and the same distance, and there cannot possibly be a relation between the distance and itself. His definition, therefore, involves an absurdity.

From all this it appears that space is, as I have said, the distance between bodies; when complete, properly termed vacuum; when incomplete, properly termed distance.

V. DIVISION. OF MOTION.

I considered space immediately after matter, because it is its reverse, its absence—the distance between its portions, and I consider motion immediately after space, because without space, matter could not possibly be put in action.

There is then no space absolutely full. This is illustrated by several bodies entering into the pores or interstices of others without proportionally increasing their bulk. Indeed were it not thus, motion could not exist; or, were it otherwise, as a solid substance must exclude every other from the place which it occupies, no solid particle could be moved from its place without he annihilationof another particle of equal bulk.

MOTION, then, is that upon which all the modes of space depend.

All bodies are equally capable of motion and rest: matter is entirely passive with regard to them. Motion, therefore, cannot begin without a cause, and rest cannot take place without interruption. Since the creation of the world, however, no new cause of motion has appeared. All changes, therefore, from motion to rest, or from rest to motion occur only in individual bodies, while motion and rest, considered as not limited to individual bodies, are perpetual.

Upon this subject, however, there is a very strange and general error. We are told that, 'if a ball was thrown from the hand of a man, or struck with a racket, it is plain that, by a volition of the man's mind, the motion was first given to his own arm, whence it proceeded through the racket from one ball to another; so that the ball, racket and arm were mere

instruments, and the mind of the man the only agent or first mover.' But this is a gross blunder: all the actions of mind proceed from external impressions and are implicitly dependant on them; so that mind has no power of begining motion, however the structure of the nervous system, may, like other matter, modify it.

'Motion,' we are also told, 'cannot have been communicated from eternity by the impulse of body upon body, because an infinite series of effects without a cause is the grossest absurdity, but must have been originally produced by a being who acts in a manner analogous to the energies of the human will'. Now those who thus express themselves are misled—grossly misled by inaccuracy of expression: an infinite series of effects may as easily exist as the shortest series: in both cases, every preceding effect is actually the cause of that effect which succeeds it. Such an infinite series is that alone of which we see any evidence. Moreover, if, as the above sentence absurdly concludes, motion must have been originally produced by a being who acts in a manner analogous to the energies of the human will, that being must, in the like manner, act in consequence of impressions from external objects. ...I leave it to those who are the abettors of this opinion to apologize for its variance with the doctrines of theology. The opinion obviously falls to the ground and affords no shadow of objection to the eternity of motion.

Ignorance or neglect, however, of the doctrine just now stated, viz. on the one hand, the perpetuity of motion generally considered, and, on the other, its speedy termination in individual bodies has given origin to two hypotheses which, next to Berkeley's (already referred to), are by far the greatest in metaphysical science: I mean those of Hume and Boscovich; Hume neglected the first, Boscovich the second branch of it.

From neglect of the perpetuity of motion, Hume could not discover that there existed any necessary connexion between causes and effects, or that we had any rational idea of power. But, at once to exhibit the foundation of the common idea of power; to demonstrate the error of Hume, and to render its real nature evident, we may suppose a ball discharged with such velocity against other three of the same gravity arranged in a straight line, as to produce motion in the first and second of them. In this case, the ball will fall with considerable momentum upon the first, and a portion of this momentum will be lost in overcoming its inertia; but, as motion in any given body cannot terminate without proportionate interruption, and as a portion only of the momentum was lost, the

remaining portion, having no adequate interruption, must of course continue; and the first ball, whose inertia was already overcome, must move on before that which was discharged against it. The inertia of the second ball then receives the remaining momentum; it is overcome: but the first ball and that discharged against it, having no surplus of momentum, now stop, together with the second, at the third. Now this, into whatever parts any one may chuse to divide it, is one connected operation. In this case, the perfect resistance of the third ball affords no idea of power; the motion of the second affords a partial idea of it; but the motion of the first affords the best instance of that surplus of momentum (the physical origin of a rational idea of power) which, because uninterrupted, carries on the balls in spite of less obstacles; and to it we thus justly ascribe power.

By this investigation, we perceive, that all natural operations implicitly depend, in every step of their progress, upon motion, and that they can only be called sequences, or causes and effects with relation to the new substances brought into action, or rather with relation to the new modifications of the phenomena of motion which these substances afford, but that, considered with regard to their fundamental nature, they are all of them the same—mere continuances of one general motion, and neither distinct sequences nor causes and effects.

By thus ascending to simple principles in this investigation—by tracing physical operations to their fundamental nature in the mere continuance of motion; all apparent want of connexion disappears; the operation is one; mysterious connexion is unnecessary; and there is scarcely even room for the question respecting physical power.

Hume, therefore, completely misled himself by the assertion that 'an effect is totally different from its cause*' Every cause and effect is exactly one and the same motion modified by the forms and the magnitudes of the different objects which it involves. In all causes and effects, therefore, there can be no want of connexion, because the same motion is continued; and there always must be power, because the momentum of the body acting overcomes the inertia of that acted upon.

Thus, the hypothesis of Hume arose from ignorance or neglect of the perpetuity of motion.

The hypothesis of Hume also arose, in some measure, from ignorance of the real foundation of the rule of philosophising 'Effectuum naturalium ejusdem generis easdem esse causas,' and from his belief that 'similarity of cause was no

* Essays: Sceptical Doubts; Part II.

necessarily connected with similiarity of effect'. Now, I think I may venture to say that the real foundation of this rule, though not hitherto pointed out, is simple in the extreme, and exactly correspondent to the principles just delivered. It is namely, that all cause and effect involve operation, all operation depends on motion, and all motion must be modified by the gravity and *form* of the bodies moving; that the form of all bodies is always *evidenced in their appearance* and sensible qualities; and, consequently, that causes *similar* in appearance must have *similar* effects*.

The hypothesis of Boscovich, on the other hand, arose from ignorance or neglect of the limitation of motion with regard to particular bodies, or from the total inapplicability of the law of continuity to them.

By the law of continuity, then, acknowledged by Boscovich as the basis of his hypothesis†, is meant, that the distance from a given place is never changed unless by passing through the intermediate distances; or, that a body cannot reach a given point without percurring the intermediate space, and cannot pass from one velocity to another without passing through the intermediate velocities. Establishing apparently this law of continuity, he endeavours from it to show, that immediate contact cannot take place between bodies. For, if, of two equal bodies moving in the same direction, the preceding has 6 and the succeeding 12 degrees of velocity, and if the posterior, with its velocity undiminished, come into immediate contact with the anterior, it would be requisite that, in the moment of time in which they do come into contact, the posterior should diminish its velocity, and the anterior increase its, *per saltum*; the one passing from 12, and the other from 6 to 9, without transition through the intermediate degrees; hence the law of continuity would be violated, which is impossible. Neither could this take place by intermediate degrees during contact. For if, at any period, one of the bodies possessed 7 degrees of velocity while the other retained 11; during the time which passed from the commencement of contact when the velocities were 12 and 8 till the time in which they were 11 and 7, the second body would have moved with greater velocity than the first and have percurred a greater space than it, and therefore its anterior surface would have passed beyond the posterior surface of the other, and conse-

* For a more ample detail of the Refutation of Hume, see the Second Volume of the Archives.

† Theoria Philosophiæ Naturalis, § 17.

quently some part of the body following would have compenetrated some part of the body preceding, which is also impossible. Hence, granting the truth of the law of continuity and the impenetrability of matter, immediate contact cannot take place. He further endeavours to show that such a *saltus* cannot exist, because that act being instantaneous, the bodies would, at one indivisible instant of time, have two different velocities. He also endeavours to prove that a change of velocities must take place in the bodies before contact; that consequently a power must exist which changes them; that this power is mutual and acts in opposite directions; that such repulsion must be encreased to infinity, the distances being infinitely diminished; that this power is attractive at greater distances; that there are many transitions from one of these to the other: and, as the distances being infinitely diminished, the repulsive power is infinitely increased, it easily follows that no one portion of matter can be contiguous to another; for, that repulsive power must perpetually remove the one from the other. Hence it would necessarily follow that the first elements of matter are entirely simple and composed of no contiguous parts.

Now the whole of this is one tissue of error. Certainly from the passage of a body from a given point, over a certain space, to another, where it does not reach the last point without percurring all the intermediate ones, and from other instances adduced, it would, on superficial inspection, seem as if the law of continuity were applicable even to individual bodies. But here Boscovich forgot that the points of commencement and termination are determined; all great obstacles to the progress of the body, which might divert it from its route, are removed; it is to pass from one to the other in a straight line; and consequently each individual point of matter or of space over which it is to pass is presupposed and directed by the very enunciation of the instance now adduced; the word 'over' actually indicating the points of space which are to be percurred. Thus the law of continuity is, if I may use the term, borrowed for a moment; or rather it is seen, as it really exists, *between* the commencement and termination of one and the same action. And, let the philosopher consider it but a little, and he will find that this affords not the slightest exception to the absence of all laws of continuity from the acts of individual substances. It will be found that Boscovich has seized but a small portion of the existence of an individual body: for, were the body to pass on, as all bodies naturally do, *its* action would terminate, and continuity, with regard to *it*, would speedily

disappear. Boscovich ought to have seen that, by limiting its course by certain points, he was excluding that portion of the experiment which could alone show him that no such law existed with regard to individual substances.

The law of continuity, then, is applicable to rest or motion generally considered, and, on that very account, inapplicable to individual bodies; because rest or motion may be transferred, but can never be annihilated. As, then, generally considered, they cannot be annihilated, hence this law with regard to them generally; and as, with regard to individual bodies, they may be transferred, hence the total inapplicability of such a law to them, and hence too the subversion of the great basis of the Boscovichian hypothesis. For, if thus the law of continuity apply not to individual bodies, it cannot in them prevent immediate contact; nor can such absence of contact lead to the conclusion that there exist no parts to be brought into this state, or that matter consists of indivisible and unextended particles*.

Thus the hypothesis of Boscovich arose from ignorance or neglect of the limitation of motion with regard to particular bodies, and the total inapplicability of the law of continuity to them.

* For a more ample detail of the Refutation of Boscovich, see the Second Volume of the Archives.

Even there, however, I have by no means entered into all the subordinate arguments and conclusions of that acute philosopher, but have merely dwelt upon and subverted the great data of the hypothesis and its leading conclusions. Boscovich, for instance, urges 'that as the particles of bodies are all more or less widely separated by heat, they cannot be in contact; that as light passes through transparent bodies in a straight line, it cannot impinge upon or come in contact with solid particles in them; that as light is reflected at a distance from the superficies of bodies, it does not come in contact with their solid particles; that as the electric fluid is seen to pass between the nearest points of the links of the finest chain when most strongly extended, these links cannot be in contact, &c. To all this and innumerable arguments of the same kind, I might have answered, that though heat separates many particles of bodies, many may yet be in contact; that light, in all probability, does suffer myriad deflexions in passing through bodies, and that the ultimate particles of these bodies being perfectly invisible, it is absurd to expect that their effects upon light—the deflections which they must occasion, should be perfectly the reverse; that Sir Isaac Newton's objection to light being reflected directly by the superficies of bodies, is unfounded, because, though the finest possible superficies is still unequal, it is quite unreasonable to expect that scratches on the surfaces of bodies which are themselves totally invisible should produce perfectly visible effects upon the luminous rays; and that though the links of a chain may be in contact, yet, if at the point of contact, they be not sufficiently broad to absorb the whole passing electric fluid, the unabsorbed portion of the fluid surrounding the minute point will assuredly be apparent, without infringing the existence of contact, &c. But I deemed it totally unnecessary to adduce such arguments as these, after the very data of the hypothesis were subverted.

VI. DIVISION. OF IMPENETRABILITY AND DVISIBILITY.

Having considered motion immediately after space, because its existence, in some measure, depended upon space, I now consider impenetrability and divisibility immediately after motion, because motion is indispensible to a knowledge of their existence.

IMPENETRABILITY expresses the fact that no one particle of solid and extended matter can be made to occupy the same place with another.

DIVISIBILITY expresses the fact, that all the ultimate particles of matter are seperable from each other*.

VII. DIVISION. OF TIME.

Having now briefly considered Matter, Space, Motion—the materials of all the great events which exist, I shall consider TIME, which has the same relation to the last of these, viz. Motion, that Space has to Matter.

As *space* expresses the distance between objects, or the number of similar objects which may be introduced between others, so *time* expresses the distance between events, or the number of similar events which may be introduced between others.

For this reason, it is said to be measured by the succession of physical or intellectual events occuring between others, just as space may be measured by the number of objects which may be introduced between others. Thus an hour is measured by 60 seconds from the event of striking 12, for instance, till the event of striking 1, or a foot is measured by 12 inches from one extreme to the other.

Time, we are told, consists of parts ultimately indivisible because if, in time, we could never arrive at an end of division, and, if each moment, as it succeeds another, were not perfectly single and indivisible, there would be an infinite number of coexisting moments†. Now here Mr. Hume ought only to have said that we could not follow its further divisibility—that, measured by the succession of our ideas, its parts would at last appear to us no lorger divisible; for, it is as absurd to talk of measuring the minuter and more rapid portions of time

* Of this, more will be said in speaking of Infinity.
† Hume's Treatise on Human Nature. Vol. I.

by the slow succession of our ideas, as it would be to talk of measuring the ultimate particles of matter by a foot-rule. Mr. Hume here egregiously deceives himself by first using the word moment in an arbitrary sense, and then speaking of its being necessarily single. For 'moment' is a mere term relative to our conception of the period, and may evidently consist of minuter, not coexistant, but successive portions. He might as well have said that day, if not single and indivisible, must consist of a number of coexisting hours.

The length of time apparent to us depends evidently on the attention paid to its succession. It is not, however, the occurence of ideas, but the occurrence of events of any kind, that indicate time. The succession, indeed, of ideas marks it most incorrectly, as we all ought to know; and to argue, that, because we must have ideas of the succession of external events before we can know them, it, therefore, must be by the succession of ideas and not of external events that we do measure time, is utterly incorrect. It would be as reasonable to say that a mechanic measures the subjects of his operation not by certain tools or instruments, but by certain ideas.

Space then is measured by instruments of a fixed and invariable nature, and time or the distance between events, by other events—by certain other series of them of a most definite and uniform kind. Such measurement alone as mind could afford either of space or time would be useless indeed. It was this notion, that matter and the circumstances connected with it were solely measured by mind, and the neglect that we alone know it invariably by comparing it parts to each other or to the whole which they form, that led to the hypothesis of Berkeley, and an error precisely similar with regard to time leads to the hypothesis which I now refute.

Duration, which is sometimes confounded with time, is entirely different. It implies continuance, which the expression 'time' does not imply, and it also further implies resistance to a destructive power. It is, therefore, quite incorrect to say that time is a mode of it.

VIII. DIVISION. OF NUMBER AND FORM.

Having now considered motion, and the impenetrability and divisibility of matter as giving origin to events, as well as 'time' or the distance between them, it is obviously next proper to consider the circumstances which result from this divisibility, &c. viz. number and form.

NUMBER is evidently the first result of the division of matter.

The idea, however, of number in general, or perhaps rather of plurality, is probably derived from similar, not dissimilar objects ; in other words, before we can consider them as forming a number, we must determine *of what* they are—we must know the general character of the genus before we can determine and enumerate the species. But the idea of definite or particular number appears to be founded also on dissimilartiy ; for before we can mark the limits of number, we must know a principle of limitation—a difference between these and other bodies.

Upon this subject, I may observe, that some most absurdly assert ' unity' to be a relation. It not only is not a relation, but on the contrary, wherever it exists, there can be no relation.

It is evidently upon number, generally considered, that the whole science of Arithmetic depends ; and it is for that reason, that I class it as a portion of Metaphysical science.

FORM is evidently the next result of the division of matter. With reference to the internal parts of bodies, it is termed structure ; with reference to their external, figure. Organization is applied to the internal forms or the structure of animal and vegetable bodies.

From internal structure arise the hardness and softness of bodies : from external figure, their roughness or smoothness.

Upon the error of the ancients, in considering forms as distinct from matter, I need not here dwell.

With regard to the form of the minuter particles of matter, it is most probable that the simplest of all forms—the spherical, accompanies the simplicity of their state of existence. The different magnitude and arrangement of these minuter forms of matter will obviously with facility constitute every compound body.

It is evidently upon form, generally considered, that the whole science of Arithmetic depends ; and it is for that reason that I class it as a portion of Metaphysical science.

IX. DIVISION. OF THE OTHER QUALITIES OF MATTER.

With the last division, the science of metaphysics properperly terminates ; for the other circumstances which I am now to mention, and which are commonly denominated qualities of

matter, belong, strictly speaking, to the Second Department of science or General Physics. I shall, however, deviate for a moment from that order, and bestow a little consideration on them here, not because I think they ought ever to be mentioned as portions of this science, but because Berkeley has founded chiefly upon some errors with regard to their nature, his great metaphysical hypothesis, and because, before leaving this subject, I wish once more to refer to that hypothesis.

These qualities, then, differ from the last mentioned, viz. Form, most strikingly in this, that they not only imply motion actually existing, but even the motion of particular substances, —in other words, they belong to General Physics. They are named seeing, hearing, smelling and tasting. The whole of these are commonly termed secondary qualities of matter.

Before, however, I show the impropriety of this arrangement, I may mention that among the qualities I have already indicated there is a remarkable peculiarity. Neither solidity nor extention have the slightst reference to motion, and I have, therefore, placed them first among qualities, and next to matter itself. Both impenetrability and divisibility imply actual motion, and I have, therefore, placed them second among qualities, and next to motion. Both number and form presuppose motion—are the result of it, and I have, therefore, placed them last. This arrangement is strikingly natural also, because they and the science of mathematics which flow from them, thus immediately precede natural philosophy or General Physics, in every step of which these previous considerations are of such indispensible importance.

The properties just mentioned, however, if considered with regard to their simplicity, may all be termed Primary, because they depend entirely upon any simple substance. The Secondary, in this view, comprehend sounds and colours, which are secondary, because they depend not only upon individual substances, but also upon media—air or light. Secondary qualities, however, have no dependence upon organs of sense; for sounds, considered with regard to their physical action, produce the same effect upon the membrana of a drum, as they do upon the membrana tympani of the ear; and perception or consciousness can have no share in their production. The Ternary qualities of matter include smells and tastes, which are ternary, because they depend not only upon individual substances, but also upon media—air and liquids, and even upon organs of sense; for we know, that, to an altered palate, sweet substances may even seem bitter, and it is impossible that sensation can change into its *opposite* any thing which is not, in

a great measure, dependent upon it. Smells and tastes, therefore, are more entirely animal than any of the other qualities of matter

Now the degrees in which qualities exist, suppose relation of one being to another, and are evidently of two kinds, either relating to an insensible or a sensible being, whence the three genera, primary, secondary, and ternary, of which I have enumerated and described the species, form two orders, or more properly series, the first of which I shall denominate insensile, and the second sensile. Now invariability is a property of the insensile, and variability a property of the sensile. Thus, to illustrate the insensile, one side of a triangle may have 'largeness' in relation to another side of the same triangle, and in this case, 'largeness' will be an insensile, and while the triangle has existence, an *invariable* quality. Thus, also, to illustrate the sensile, the side of a triangle may have 'largeness' in relation to an animal, and, in this case, 'largeness' will be a sensile, but it will also be a *variable* quality, because it may be large in relation to one animal, and small in relation to another, or it may even vary to the same animal according to the different states of its senses.

From ignorance or neglect of this simple and natural division of qualities arose the hypothesis of Berkeley.

Overlooking the real nature of qualities, he did not even define the term, but proceeding in total darkness, he considered only the sensile qualities of objects—their qualities in relation to us—to organic and variable beings, and *from their variability declared these objects to be the mere creatures of sensation;* he neglected the insensile qualities of objects—their qualities in relation to themselves, or to inorganic and invariable beings—relations which alone constitute all the real, because immutable existences in nature *.

Now it is from Matter, Motion, and the various qualities which I have described, that originate all the particular substances in nature. Of these a given distance with relation to several objects constitutes place.

It is improper to term Place a mode of Space, because 'space' is the whole distance between objects, and 'place' the relation which that distance has to several. It also differs from 'scite' in this, that the latter has a reference to a particular object, and from 'situation' which supposes the actual existence of an object in it.

* For a more ample detail of the Refutation of Berkeley, see the First Volume of the Archives

Mr Locke errs in saying, that ‘ place is the relation of istance between two or more points which are considered as as rest ;’ for there can be no relation of distance between two points : the distance alone can have no relation ; it must have a rela ion *to* something in order to avoid absurdity ; but to itself, it can have no relation ; and even if we were to grant that the distance between two points had relation to the two points, yet this would never indicate a given place in that distance. Mr Locke’s words are absolutely without a meaning.

APPENDIX TO THIS GENERAL VIEW OF METAPHYSICAL SCIENCE.

OF INFINITY AND ETERNITY.

Having mentioned the doctrine and science of number and form as the proper conclusion of metaphysics. and having now advanced further by describing qualities of matter which result from general physical action, I shall say little of the subjects of infinity and eternity, which I do not consider as either the most legitimate or useful subjects of metaphysical science. Happy indeed would have been for this branch of philosophy, if its cultivators had always remembered that ‘ the truth of being and the truth of knowing are one, differing no more than the direct beam and the beam reflected *.’

Numerous errors in metaphysics, however, have arisen not only from discussion about nonentities, but also from abuse of language. Thus, we are told that, in metaphysics, ‘ *infinity is something positive*, to which nothing can be added.’ Now infinity is nothing positive—nothing definite to us: indeed ‘ infinity’ and ‘ something positive,’ are a contradiction in terms. We are also told that infinity in its first sense, denotes the *absence of limit from the quantity* to which it is ascribed.’ Now here also ‘ absence of limit’ from a ‘ quantity’ is a palpable contradiction. In fine, to apply the indefinite epithet ‘ in- ‘ finite’ to quantity or number which are definite, is an absurdity in terms.

* Bacon, Of the advancement of Learning, Book I.

Space being the distance between body cannot be infinite; for the very existence of the bodies between which it is, precludes this. Matter cannot be infinite; for the very existence of that vacuity which permits motion, precludes this.

INFINITY, then, is matter and space without termination. Matter it appears may added to or subtracted from matter; and space may be added to and subtracted from space beyond our power of numeration. Hence we imagine infinity. But to attempt to point out the relations of that which has no limit—to talk of adding to or subtracting from that which we know not, is absurd. To use the very term infinity, is to grant our ignorance of the amazing extent of that which the term designates, and to talk of adding to or subtracting from it, as it implies a knowledge of its parts, is to assert our acquaintance with that of which we had immediately before granted our ignorance. We can only say, that matter interrupted by space extends as far as our knowledge of extent.

On the other hand, as to infinite divisibility, we can only say that we know of no matter which is indivisible. I no sooner distinguish an object than I distinguish its parts, and analogy entitles me to conclude that, of the smallest objects with which I may become acquainted, I shall also distinguish the parts. Now of whatever object I can distinguish the parts, I know it to be divisible, and analogy also entitles me to conclude that, of whatever objects I may distinguish the parts, I shall also find them to be divisible. But in favour of the indivisibility of matter, there is neither demonstration nor analogy.

When, by the term 'eternity,' philosophers attempt to designate something positive or definite, they make the same error with regard to it that I pointed out with regard to infinity. Eternity has the same relation to motion that infinity has to matter.

ETERNITY expresses events and their intervals without termination. Time, it appears may be added to or substracted from time beyond our power of calculation, and we can have no conception of eternity, but as portions of time beyond our means of reckoning. Hence, then, we imagine eternity. But (as already observed respecting infinity) to attempt to point out the relations of that which has no limit—to talk of adding to or subtracting from that which we know not is absurd. To use the very term of infinity, is to grant our ignorance of the the amazing extent of that which the term designates, and to talk of adding to or subtracting from it, as it implies a knowledge of its parts, is to assert our acquaintance with that of

which we had immediately before granted our ignorance. Our knowledge, then, cannot extend beyond events; and wherever they have been, time must have been. Time, indeed, as dependant on motion, can no more have had a beginning than it. We know of no commencement either of events or of time, nor are we authorized to conjecture any termination of them. Hence we cannot even conceive the reverse of eternity.

The great argument against eternity as applicable to the succession of events is, that 'an actual infinite succession of moments implies an absurdity: for such a succession should consist of as many years, as it should of moments; and thus the whole, and the parts composing the whole, would be equal. If we suppose an infinite number of years, assuredly the number of moments, of which those years consist, must be still greater, and exceed infinity, which is absurd. Thus, if an infinite succession of moments passed before the creation of the world, must it (*this infinity*) not be encreased by the number of them that have elapsed betwixt that time and the present.'* Now the whole error in this reasoning arises from a misconception of terms. Infinity and eternity, we must conceive, because we can have no conception of a limitation either of matter, or motion, of space, or of time, and on its being suggested, we are almost inclined to ask 'what exists where they terminate;' but while we can thus generally conceive them, we, as the very words imply, know them not sufficiently intimately to understand their relation to us. How indeed can that of which the very name indicates that it has no limits, bear any relation to us. It is obviously too indefinite to admit of it. There is in it nothing marked and fixed to admit of relationship. We may speak of the relationship of such of its parts as are known, but to talk of the relationship of those parts to infinity—of known to unknown objects or events, is an abuse of language and an absurdity. To speak of addition to or subtraction from that to which even the term extent is not strictly applicable, is glaringly wrong. We might with equal propriety compare the present time or events, with events unknown to us. After granting these to be unknown, it would be madness to say that the one was greater or less than the other. Hence all ar-

* Kirwans Metaphysical Essays, and various other works.

guments of this species against infinity and eternity (and these are the only kind, worthy of notice, which have been used against them) fall entirely to the ground.

Dr Clarke's error upon this subject was in assuming our possession of so perfect a knowledge of infinity and eternity, as inevitably to imply a knowledge of their relations, and in then denying that finite parts had any relation to them ; whereas he ought only to have denied our power of discovering the relations of known to unknown events, &c.

PATENT OFFICE LIBRARY.

SECOND DEPARTMENT OF SCIENCE, OR GENERAL PHYSICS.

ASTRONOMY.

ON THE NEW PLANETS.

BY DR GAUSS.

Dr Gauss has sent to the Royal Society of Gottingen the following observations of two of the new planets.

1st. Observations of Pallas.

1806.	Mean time *hours.*	Apparent right ascens.	Apparent deelination.
Feb. 14.	8 11′ 16″	70° 16′ 31″	19° 59′ 13″ S.
16.	7 32 28	70 42 39	19 20 44
17.	6 52 38	70 56 44	19 1 8
20.	7 49 35	71 39 2	18 5 0

2d. Observations of Juno.

1806.	Mean time. *hrs.*	Apparent right ascens.	Apparent declin.
Feb. 17.	9 42′ 0″	173° 46′ 45″	0° 28′ 32″ N.
20.	10 49 47		0 54 18
	10 59 2	173 15 57	
	13 12 18	173 15 15	

The following observations of Juno were made at Gottingen.

1806.	Mean time. *hrs.*	Apparent right ascension.	Apparent declin.
March 10.	9 53′ 56·3″	169° 46′ 54·5″	3° 41′ 50·5″
11.	10 32 22·7	169 34 18	3 51 56·5

Dr Gauss has likewise sent new elements of the orbit of Ceres, deduced from the last opposition observed by professor Pasquich, which the doctor means to render more correct, when he has observations of this opposition on which he can better rely.

Epoch of the longitude, meridian of Seeberg	108°	19′	34·7″			
Diurnal tropical motion			770″	85′	84	
Annual	78	9	23			
Aphelion, 1806	326	37	59			
Annual motion	+	2	1·2			
Ascending node, 1806	80	53	23			
Annual motion	+		1·5			
Inclination of the orbit, 1806	10	37	34			
Annual diminution			0·4			
Eccentricity, 1806	0·0783486					
Annual diminution	0·0000058					
Log. of the greater semiaxis	0·4420728					

Observations of Vesta.

1807.	Mean time. hrs.			Apparent right ascension.			Apparent declin.		
April 1.	9	50′		183°	28′		12°	5′	N.
5.	11	17	2·784″	182	33	10·92	12	24	19·1″
6.	11	12	16·022	182	20	47·91	12	27	54·4

The first of these is by Dr Olbers, the other two from the observatory of Gottingin.

Dr Gauss has determined its elements in the following manner.

Epoch of the mean longitude at Bremen, March 29, 1807, at 12 o'clock, mean time	193	8	4·6″ *
Longitude of its perihelion	249	7	41
——— aphelion	96	57	52
——— ascending node on the ecliptic	103	8	36
Inclination of its orbit	7	5	49·5 †
Diurnal tropical motion	0	16	18·91
Logarithm of the mean distance	0·3728428		
Eccentricity	0·097505		

* In the Magazin Encyclopédique it is 192° 9 54″.
† Ibid, 7 8′ 34″.

Greatest distance from the sun....	25.625
Least	21.514
Period of its revolution.....	1321 days, 12 hours.

NEW CONSTELLATION.

The University of Leipsic has resolved, that the stars belonging to the belt and sword of Orion, as well as the intermediate stars, which have yet received no particular name, shall in future be called the stars of Napoleon, or the Constellation Napoleon.

The villanies of Napoleone Bounaparte, and the baseness of the numbers of a German university are odd subjects of immortality !

HYDROGRAPHY.

REMARKS ON SOME POINTS OF HYDROGRAPHY.

BY MR LEBLANC, OFFICER IN THE FRENCH NAVY *.

The gulf of Florida, or now Bahama Channel, is greatly frequented by ships of all nations, that trade to or cruise in the Gulf of Mexico ; yet the latitudes and longitudes of the principal points in it have not been fixed. They are mentioned in the Tables inserted in our Connoissance des Temps, or in the English collection entitled ' Tables requisite', &c. Accordingly we are obliged to have recourse to the most modern charts. French navigators use the General Chart of thc Atlantic Ocean published in 1791, and revised and corrected in 1792. I think I can show, that there exists an error in longitude of 52′ with respect to all the points of the gulf. I was led to notice this on the following occasion.

On the 25 of January, 1807, in the afternoon, on board the Foudroyant, we saw waves and breakers on the North of the Great Bahama. At 4 o'clock we set, at a small distance,

* Journal de Physique, vol. LXV, p. 55.

Lena Key N 80° E, and that of Azena N 45° E by compass. The longitude given by our time-keepers No. 40 and 76, reduced to that hour, was only 80° 17′ 30″, while that by the chart was nearly 82° 15′. Whence it follows, that the whole course of the gulf is too far west about 52′ of a degree, a considerable error in those latitudes. The going and state of the two timekeepers had been carefully observed during our long stay at the Havannah. Their errors were almost nothing after we had been at sea eight days, when we had soundings abreast of Cape Henry. The results given by the observations taken with the reflecting circle gave us no reason to suspect any thing incorrect in the longitudes: and when we entered Brest, the absolute error of No. 40 was only 7′ of a degree after a voyage of thirty-five days.

Green Key is one of the principal marks of the Old Bahama channel. The English call it Chesterfield. There is a small error in the latitude of this Key, as given in our Connoissance des Temps. In our voyage I ascertained it to be 22° 7′, instead of 21° 55′. The want of tolerable charts of this dangerous part, and the necessity of comparing the ship's place on the chart with sure data, render this observation interesting for those who sail without a pilot on board. As to the longitude, it was agreeable to what I obtained by the timekeepers. This key must not be confounded with another of the same name on the south of the Great Bank of Bahama, and almost in the same latitude.

The accuracy of both of the obervations here given I have verified by comparison with two Spanish charts published in 1779 under the ministry of Mr Langara, and derived from the Hydrographer's Office at the Havannah.

I know not where the latitude and longitude of San Salvador, and of the principal cities of Brazil, in the Bay of all Saints, are to be found. When we anchored in that bay, Mr Fonsera, Captain in the Portuguese navy, and superintendant of that harbour, told me, that its latitude was 13° and its longitude 42° 25′. An English work, in the hands of all the navigators of that country, gives them 12° 46′ and 41° 5′. So considerable a difference led me, to pay as much attention to the subject as our short stay would permit; and I had an opportunity of finding both by lunar observations and the timekeepers, that its true longitude is about 41° 5′. The latitude of point St Antony I ascertained by several observations to be 12° 59·8′. The time of high water is twenty minutes after three, mean time. The variation of the needle there in 1806 was 10° 20′ E.

METEOROLOGY.

OBSERVATION OF A LUNAR RAINBOW.

BY L. CORDIER, MINE ENGINEER *.

I was lately witness of a pretty rare phenomenon, a rainbow in the night. The 13th of this month, August 1807, I was standiug with several persons on an eminence, that commanded a view of the horizon. We had near us, to the north, the tail of a storm, that poured down a copious rain. At the same time the sky cleared up toward the south, and the moon, nearly at full, appeared. A fine luminous bow then appeared on the storm ; but, though it was well defined, the the seven primary colours were scarcely to be distinguished in it. They seemed as if drowned in a tint of pale yellow. What struck us particularly was, that the whole of the circle encompassed by the bow was luminous, and tinged with a similar yellow hue, though less intense.

FALL OF METEOROLITES.

In the afternoon of the 13th of March, 1807, in the circle Ichnow, and government of Smolensko, a very violent clap of thunder was heard in that district. Two peasants in the village of Timochim, being in the fields at the time, say, that at the instant of this tremendous report they saw a large black stone fall about forty paces from them. They were stunned for a few minutes, but, as soon as they recovered themselves, ran toward the place where the stone fell. They could not discover it however, it had penetrated so deep into the snow. On their report several persons went to the spot, and got out

* Journal de Physique, vol. LXV, p. 208.

the stone, which was above two feet beneath the surface of the snow, It was of an oblong shape, blackish like cast iron, very smooth on all parts, and on one side resembling a coffin. On its flat surfaces were very fine radii resembling brass wire. Its fracture was of an ashen grey. Being conveyed to the gymnasium of Smolensko, a professor of natural philosophy there considered it at once as ferruginous, from the simple observation of its being extremely friable, and staining the fingures. The particles of which it is composed contain a great deal of lime, and of sulphuric acid.

On the 19th of April, 1808, at one o'clock in the afternoon, a great quantity of meteorolites fell in the commune of Pieve di Casignano, in the department of Taro (formerly the duchies of Parma and Placentia). The air was calm, and the sky serene, but with a few clouds. Two loud explosions were heard, followed by several less violent, after which several stones fell. A farmer, who was in the fields, saw one fall about fifty paces from him, and bury itself in the ground. It was burning hot. A fragment of one of these stones is deposited in the museum at Paris.

GENERAL HYPOTHESIS IN GENERAL PHYSICAL SCIENCE.

BY THE EDITOR.

I. DIVISION. INTRODUCTORY OBSERVATIONS.

The precise nature, use and value of hypothesis and theory seem to me to be by no means generally understood. Theory is often deprecated; hypothesis almost always. Yet the occasional utility of, I will venture to say, both must often have been felt. Previous to the times of Lord Bacon, science was little more than hypothesis; now it abandons even theory. Both methods I believe are erroneous, though the last is certainly least so; but it is least so, solely because a total abandonment of theory is impossible, and equally so is a total abandonment of hypothesis. Both have their value; both are essential to the progress of science.

To prove this last assertion is my first object. Now hypothesis appears to me to be a conjecture, or series of conjectures concerning the causes and relations of events: theory appears to me to be the confirmation of such conjecture, or a knowledge of the causes and relations of events.

The value then of theory—of a knowledge of the causes and relations of events cannot for a moment be questioned. It is by that means alone that we can discover the probable effects of any mode of action which it may be necessary to adopt under circumstances of the highest importance and the utmost emergency; it is by that means alone that every act of our lives is not us as a new experiment, and that under very different circumstances, we can precisely and confidently calculate results; it is, in short, by that means alone that we can reason. The value of theory then cannot be questioned. But I have stated, that as hypothesis is conjecture, so theory is its confirmation or actual knowledge. Now it is obvious that where there is no conjecture there can be no confirmation; where there is no hypothesis there can be no theory. It is obvious that we must suppose a reason before we can discover the number of the facts which support and confirm it—which transmute it from a hypothesis to a theory. In short, we can never bring together any series of facts, but by means of the supposition that their causes and relations are similar: without a hypothesis, we have no motive to do so. Hence all theories must in the first instance be hypotheses: hence both are essential to the progress of science.—The steps of ascent, though humbler and less desirable, are not less necessary to an extensive prospect than the summit which by their means we reach, and from which the view is unlimited. The notion, then, that while theory may be admitted, hypothesis is inadmissible in science, is entirely founded in error. Both have their value; but each too has its sphere of application and utility.

It is from the value and misapplication of theory and hypothesis, that the greatest dangers to science have arisen, and that the utility of both has been doubted.

It must speedily have been felt that the capability of discovering the causes and relations of events—the capability of theorizing, conferred a decided preeminence upon its possessors. To such a preeminence all would aspire—all would attempt to theorize—many would inivitably err. Hypotheses must first have been formed; and, in many suppositions upon one subject, one alone could throughout be correct. Hence, with the number of hypothesis, the number of errors

would accumulate; the order of their sequence would soon lead some to deem hypothesis the cause and error the effect; and the opprobrium of the latter would soon be bestowed upon the former: hence, hypothesis would soon be banished and even theory, as allied to it, would scarcely be tolerated in philosophy. Such—precisely such has been their fate in the history of science. Their ultimate abandonment or neglect has arisen from their value, the wish to appear in possession of them, and their consequent misapplication.

On one hand, a theory which is founded on the broadest basis and accounts well for many phenomena must not, on the appearance of one or two facts which seem at first sight contradictory to it, be instantly abandoned. Before we can be satisfied that they are contradictory, we must carefully examine them, and the examination may terminate in their reconcilement. Hastily to decide that a theory is incorrect, because some new facts do not appear to be accounted for by it, is certainly unfair, and to decide in this manner when these new facts are peculiarly minute, evanescent and difficult is highly blameable. Such conduct tends only to hold unfixed the bases of science and to impede its progress; and such, for instance, has been the effect of the systems of Berkeley, Hume and Boscovich. It is, however, fortunate for truth, that when obstacles are thus thrown in the way of science, and when these are removed, its data are thereby illustrated and its progress more amply insured.

On the other hand, the utmost caution is obviously necessary in the adoption either of a hypothesis or a theory. That hypothesis which would account for the greatest number of phenomena must evidently be deemed the most probable; but that by which any phenomena were unexplained would not be entirely satisfactory, and that to which any were in contradiction would not be embraced. When, however, an hypothesis is embraced, the mind if well constituted must still be open to the impressions of the senses, and a new hypothesis which may not less satisfactorily account for a greater number of them must meet the most welcome reception.

It is under these impressions, and at the same time under a conviction that the causes and relations of events—that the operations of nature are simple in the extreme, that I have been led to the following hypothesis. That, that hypothesis is not applied to account for all the phenomena, and that it may even, at first sight, appear to be in contradiction to some of them, I am not disposed to deny. But it is perhaps sufficient to entitle it to some attention, that though

of extreme simplicity, it does not fail to account for a greater number of phenomena of the highest importance than were perhaps ever before brought under one general law.

In the first divisions of the paper, however, I shall briefly consider some subjects which I reckon necessarily preliminary to the detail of the hypothesis itself.

II. DIVISION. BRIEF VIEW OF GENERAL PHYSICAL LAWS.

It is obvious that, by some power, the various bodies forming our planetary system are retained at a certain distance from each other, and the slightest consideration will show that this power must be of more than one kind or must operate in more than one direction; for if they were only under the influence of a direct impulse, they would be carried forward in a straight line and would not move in an orbit.

As bodies moving in an orbit have a tendency to fly off from it, a power repelling the planets has not been deemed of such essential importance as one drawing them toward each other, and another impelling them forward, by which alone their circular path might be effected.

The force by which the planetary bodies are said to be drawn toward each other is termed attraction—planetary attraction.

The force by which the planetary bodies are urged forward in their path may be termed impulsion, and the motion which it induces is denominated their projectile motion.

The last of these powers—the force by which the planetary bodies would be prevented from too nearly approximating each other has been denominated repulsion.

The power also by which heavy bodies descend is termed gravitation, or the attraction of gravitation, and has been shown by Sir Isaac Newton to be the same with planetary attraction.

The power by which various bodies are said to attract iron and to point toward the poles of the earth is termed magnetism, and the bodies themselves are termed magnetic.

The power by which the particles of homogeneous bodies are said to attract each other and to remain in connexion is termed the attraction of cohesion or aggregation. It is in this way that two particles of quicksilver, when nearly in contact, unite, and that polished plates adhere.

The power by which fluids ascend in capillary tubes or in the angle formed by two polished plates is termed capillary attraction.

The power by which a rod of gold, for instance, is indelibly stained of a white colour by mercury into which it has been plunged has received no peculiar name, though certainly as much entitled to it as some of the phenomena just mentioned.

The power by which the particles of heterogeneous bodies are said to attract each other, and also to form new combinations, as a particle of oxygen and hydrogen in the formation of water, is termed the attraction of composition, and on the various degrees of this affinity or attractive power subsisting between bodies, depends almost all the operations of chemistry.

The power by which a glass tube, when heated by rubbing, alternately attracts and repels light bodies is termed electrical attraction.

I thus obtrude upon the reader a very brief notice of these well known laws, commencing with the greatest and most invariable, and terminating with the most minute and evanescent, because previous to the remarks which follow, such a notice may to some be useful.

III. DIVISION. GENERAL OBSERVATIONS ON THE FOUNDATIONS OF THESE LAWS, OR ON THE CAUSES OF THE PHENOMENA TO WHICH THEY REFER.

With regard to the causes of these phenomena, it excites my peculiar regret when I hear philosophers use such language as the following, 'Whether it (attraction) be inherent in these bodies themselves, or the consequence of some foreign agent, are questions altogether beyond the reach of philosopy, because we have no method of deciding the point.'

To assert that any thing is placed beyond the limits of the human understanding is the grossest absurdity, because it not only presumptuously presupposses that we have fixed and determined these limits, but also that we have such a knowledge of the very object, with which we are asserting the impossibility of human beings ever becoming acquainted, as to enable us to point out its relations to these limits; —it is, in short, absurdly to assert that we are acquainted

with the relations of an object while we are totally ignorant of the object itself.

It is equally strange that even those first principles of all philosophy which not only have a foundation in that general sense of mankind which is improperly termed intuition, but which accord with universal experience and reasoning, should be threatened with subversion whenever some philosophers feel themselves at a loss to account for a phenomenon which to them may appear inconsistent with that experience—it is strange that on the ground of one or two insulated facts—facts which they must not have taken the trouble to investigate, they should under the pretence of rejecting all hypotheses, assume only a new hypothesis founded on the narrowest base, abandon rational theory resting upon numerous data, and attempt to subvert its conclusions. In this case, the pretence to impartial investigation and the rejection of hypothesis, is in general only the means of introducing new hypotheses; and indeed there are many cases in which the rejection of one hypothesis cannot take place without the adoption of another.

Precisely such is the abandonment of the principle that 'a body cannot act where it is not'. It is impossible to abandon this principle without adopting the opposite one that 'bodies can act where they are not'. Now, while the former of these principles is directly and strongly supported by almost the whole amount of our experience, the latter has been supported only by some curious reasoning and apparently anomalous facts adduced by Boscovich. The reasoning, however, I have in a previous paper*, shown to be one tissue of error and mistake, and even the apparently anomalous facts in natural philosophy which were adduced in aid of it become on slight consideration strictly reconcileable to the opposite principle, to which indeed it would seem no exception can exist.

The last resource to which some fly upon this subject, that 'the Almighty might as easily bestow upon matter the power of acting upon matter at a distance, as when in actual contact is puerile in the extreme; such language is a pitiful apology for philosophical investigation, and if similar reasonings were admitted in the various departments of science, it would speedily be sunk in barbarism.

To pretend then to fix the limits of the human understanding is presumptuous in the extreme, and to assert that any thing is placed beyond these limits involves the most

* Refutation of Boscovich, 1st vol. of Archives.

palpable absurdity. To have recourse also, on every difficult occasion, to the immediate agency of the deity in order to explain phenomena is not only unphilosophical but puerile and contemptible, and, on similar occasions, to abandon such indisputable axioms of science as that 'a body cannot act where it is not' shows a mind totally unfit for profound investigation. No body can act where it is not; for action in any place presupposes existence in the same place. Action without body is even inconceivable; for there can be no motion without something moving.

IV. DIVISION. OF THE OPINIONS OF SOME PHILOSOPHERS RESPECTING THESE CAUSES, AND PARTICULARLY OF THE HYPOTHESIS OF LE SAGE.

The profoundest philosophers have not, however, erred in this way. Galilei supposed gravity to involve something acting. Sir Isaac Newton also says 'Rationem harum gravitatis proprietatum ex phœnomenis non potui deducere', thereby evidently supposing that they had a cause. He further observes 'Lest any one should think that I place gravity among the essential properties of bodies, I have subjoined one question concerning its cause; a question, I say, for I do not hold it as a thing established'.

No hypothesis has been formed respecting the whole of these laws; and indeed philosophers seem never to have thought of bringing them into one simple and clear point of view. Various hypotheses, however, seem to have been formed respecting some of them individually considered, and especially respecting the first of them.

Of these hypotheses one of the most remarkable is that of Le Sage, of which the following is a brief sketch.

'Imagine that throughout space innumerable corpuscles of infinite minuteness are in perpetual motion, and that every atom has its peculiar direction, and moves for ever in a straight line, with a velocity far exceeding that of light. It is obvious that the directions of these corpuscles may be so various, that they themselves may be so small, and that their velocity may be so great, that, though they succeed each other at immense distances and leave space comparatively empty, yet they may abound every where in such a manner, that, in a portion of time almost infinitely small, a great number of them may pass through every point of space. To whatever point of

space, therefore, we turn our attention, we may consider it as a centre to which the motions of an infinite number of corpuscles have a reference, either diverging from or converging to t.'

'This constitution, of what Le Sage terms the gravific fluid, being conceived, imagine a solid body to be plunged into it, of any figure whatever larger than one of the corpuscles, and in a certain degree, if not entirely impervious to these corpuscles. This body will remain at rest, or at least without any progressive motion, the impulses from the corpuscles impinging upon it being equal in opposite directions. It may oscillate, but cannot be forced from its place.'

'Now let there be plunged into the gravific fluid another body, of any figure and at any distance from the first. These two bodies will immediately begin to move toward one another, for the one serving to protect the other from a certain number of the corpuscular impulses, the currents thus left without opposition must necessarily produce their peculiar effect, and impell the bodies toward each other. Their motion toward one another will be continually accelerated; and the force producing that acceleration will increase, in proportion as the one body prevents more of the currents from falling on the other; that is, nearly as the squares of the distances diminish'.

'Again if the solid particles of which the bodies are constituted, be impenetrable to the gravific corpuscles, but the bodies themselves, on account of their porosity, permeable by them, in a certain degree, the number of corpuscles that are stopped by each of the bodies will be, *cæteris paribus*, proportional to the number of solid particles, that is to the quantities of matter in the bodies; and hence in general the force urging the bodies toward each other will be directly as their masses, and inversely as the squares of their distances. Thus, by mechanical action, the Newtonian law of gravitation is explained in all its parts'.*

Against this ingenious hypothesis, Boscovich urged the objection that, as no particle of this gravific fluid would ever return to its place, or ever pass a second time through the same point of space, they would soon escape from the limits of the sensible universe, and be wasted on the deserts of uninhabited extension; that the expence of matter required to uphold the existence of this fluid is altogether inconceivable; and that the notion of the almost creative power which these new existences would require, being occupied in the production of objects which are to be only for a limited time useful, and

* Essai de Chymie mechanique, &c.

which through all the rest of eternity are to serve no other purpose whatever, is quite inconsistent.

Now it is strange that, while the very argument which Boscovich uses involves the idea of eternity, he should forget altogether that of infinity. It is absurd to suppose that, because the gravific corpuscles might pass beyond the *sensible* universe, they would therefore be lost. We can conceive no limits to the extent of the action and utility of these bodies. As to their immense number, it is as easily conceivable as the immensity of space, &c. nor could it be difficult for him who was able to create one of these corpuscles, to create myriads of them. The whole argument of Boscovich is strikingly weak; and indeed the attempt to limit the universe, and to grudge the expenditure of matter is excuseable in him only who grudged to it even one solid particle, and wanted the universe to be composed of innumerable nothings.

To the hypothesis of Le Sage, however, there seem to me to be insuperable objections. He says of two bodies plunged in this imaginary fluid, that their motion toward each other will be continually accelerated, and the force producing that acceleration will increase in proportion as one body stops more of the currents from falling on the other. Now this reasoning must be applicable to planetary attraction as well as to gravitation; for Newton has clearly shown these powers to be the same; and thence it follows that the nearer two planets approach, the greater will be the number of the currents which are impeded by both, and as it is obvious that the power which first impelled them to each other must thus become every moment more powerful, these bodies would at last rush together with inconceivable velocity. To repulsion, in order to prevent this, M. Le Sage cannot have recourse; for that would only be to explain mechanically one power, in order to introduce another not less mysterious. Besides, whence is to arise the projectile motion by which the planets proceed in their orbits?... Thus, the hypothesis by no means accounts for the various phenomena. To this hypothesis, however, it is above all to be objected that it is not founded even upon one fact.

V. DIVISION. OF THE NEW HYPOTHESIS.

Now to me it appears that all these laws refer to the motion of different bodies as influenced by one and the same agent or medium, and that, though they appear various, their nature is simple in the extreme. They seem various, because they

refer to different bodies, and they are in reality simple, because their agent or medium is one. Thus they refer to the planetary motions, the fall of heavy bodies, the direction assumed by magnetic substances, the junction of homogeneous particles, the ascent of fluids in capillary tubes, the combining of heterogeneous particles, and the actions of electricity—subjects of great variety; but the medium in which these actions take place is one and the same, viz. the aeriform fluid by which all bodies are surrounded, which the powers of the air-pump are incapable of removing, and the absence of which we are consequently not entitled to assume in any philosophical investigation.*

As then the existence of the various subjects of these laws and of the air as their medium, is incontrovertible, and as this simple fact is the basis of my hypothesis, it is obvious that it does not, like that of Descartes, Le Sage, &c. require any imaginary being, but one of real existence, and has, in this respect, the character, not of mere hypothesis, but of accurate theory.

It will, therefore, be according to the accuracy with which I may delineate and explain the *actions* of these bodies that my hypothesis will assume the higher degrees of probability, or acquire even the rank of theory.

Now, in making the next step—in proceeding from the simple foundation of my hypothesis—from the existence of the bodies above referred to, to the actions of these bodies, I might avail myself of authority, by introducing that of Boyle, with regard to the internal motion of matter; for upon that, I could raise the whole of my superstructure; but, I have time to reason, and feel no regard for authority. A fact equally simple with the first which I have adopted, and equally incontrovertible, will afford the means of raising and perfecting my plan. That fact is the perpetuity of motion...The state either of rest or motion may belong to individual bodies; but motion can never terminate in one body without being communicated to another. A cannon ball, which is not stopt by impinging upon any obvious obstacle, gradually approximates the ground only by communicating its motion to the air by which it is surrounded; and even if it impinges upon any body which it is incapable of evidently moving from its place, it nevertheless communicates to it a proportional vibration which passes from it to the contiguous bodies and the medium in which they exist. Thus motion never terminates either wholly or in any proportion in one body without being communicated correspondingly, viz.

* The incorrectness of such assumption, and the dangers which it involves, I shall further illustrate in the sequel.

either wholly or in similar proportion, to other bodies. The perpetuity of motion is, therefore, undeniable.

As then the perpetuity of motion is also incontrovertible, and as this simple fact affords the means of raising and perfecting my plan, it is obvious that it likewise involves no imaginary being, but one of real existence, and has also, in this respect, the character, not of mere hypothesis, but of accurate theory.

It is now, therefore, according to the accuracy with which I may trace this continuity of motion through the subjects and medium already referred to, and the various modifications of it which they produce, that my hypothesis will assume probability and value, or even the rank of theory.

For this purpose, I shall first show, that there is a continuity of motion between the various bodies constituting our planetary system, as, for instance, between the earth and the sun, and shall then show how it influences, and is modified by the great classes of objects which that space involves. If I can establish the first fact referred to, a point of great importance is gained in the progress of this hypothesis—a point indeed of such importance, that in it chiefly the value of the hypothesis must consist, and no difficulty in its application to individual objects can possibly infringe it.

Now it is an undeniable fact, that motion passes more easily from heavy to light bodies than from light to heavy ones. Thus, if a heavy body be thrown into a considerable expanse of water, the water will be moved in every direction, while other very heavy bodies placed in it will remain more or less stationary, and along their sides the lighter fluid will pass in currents of greater or less velocity. Thus also, a piece of wood or stone being impinged upon one of much greater magnitude may not produce motion in it, but it will infallibly move the aeriform particles and light bodies in its passage, and the reaction or vibration of the wood or stone impinged upon will also produce a similar effect on the lighter bodies contiguous to it—in short, so much of the motion as terminated in it will be communicated either directly or indirectly to the circumambient air. Motion passes, therefore, with difficulty from light to heavy bodies, and with facility from heavy to light ones. Hence, indeed, light bodies are termed the more moveable.

The cause of this mode of the propagation of motion, and the foundation of the law which expresses it, is of two kinds; first, that in the passage of any body, whatever obstacles of a lighter kind exist, they are removed by it, and its power of mov-

ing heavy bodies is thereby diminished in a less or greater proportion, and, if its progress be even entirely resisted by an individual object, it must then be expended upon still lighter bodies—the aeriform particles; and secondly, that the velocity of all bodies is continually imparted to the medium in which they pass, and being thereby continually diminished, is rendered fit for the motion only of still lighter substances.

Thus, it appears that much of all the motions which take place upon the surface of the earth is directly communicated to the air, while even the remainder arrives at it after having passed through other bodies. In fine, as almost all motion takes place in the air, as its particles must be removed before other bodies can pass through it, and as the removal of these particles is perpetuly diminishing the velocity of passing bodies while any motion exists in them, it follows that ultimately all motion must pass from bodies to the air.

The law, therefore, of motion to pass from heavier to lighter bodies is incontestible, and its cause evident; and so far we thus proceed in accurate theory.

Now the structure of this earth is, upon the whole, more dense, and its masses heavier as we approach its centre; its superficies, on the contrary, is lighter; the animal and vegetable productions which cover it are lighter still; still lighter is the air; and its various strata are lighter as they ascend, till on the tops of the highest mountains its rarity is extreme. As, then, it has been shown that all motion invariably passes from heavier to lighter bodies, and as it appears that all bodies become light in proportion to their distance from the earth, it follows that all motion must ascend from the earth's superficies. The ascent of sound illustrates the same fact.

The law, therefore, of motion to ascend is also incontestible and its cause evident; and thus far we still proceed with accurate theory.

We may, therefore, consider as established three laws of motion, viz. its perpetuity, its more easy communication to light bodies, and its ascent.

Now the quantity of motion perpetually existing upon the surface of the earth is almost inconceivably great. The actions of animals are in general very obvious, and, even during their state of greatest rest, minuter motions occupy their whole frame; vegetables are always similarly, though less evidently, in motion, not only the internal motion of their fluids, but the absorption and exhalation of their surfaces, keeping the circumambient air in perpetual action; minerals too, as Boyle has shown, are not only always agitated by an

internal motion, but are exhaling at their surfaces, forming atmospheres around them, and undergoing perpetual changes. Indeed this philosopher has clearly shown, that all the particles of matter are in perpetual motion—a motion, too, which, being derived from the actions of external bodies, illustrates that perpetuity of motion which I have been describing. Were we, however, even to deny the internal motion so ably demonstrated by Boyle, and to confine our data only to those obvious and universal motions which every moment's observation presents, viz. to those involved by the mineral processes of evaporation, decomposition and new combination, the vegetable ones of absorption, circulation and exhalation, and the animal ones of the same kind, and of respiration, intellectual action and obvious loco-motion, we cannot help perceiving, wherever we turn our eyes, the perpetuity and universality of motion.

Thus, the earth presents one moving surface—a surface from every point of which innumerable vibrations are every instant ascending in uninterupted succession. Hence, it undeniably follows, that a flood of aerial impulses is always radiating from it. Indeed the universality of motion being thus demonstrated, and its perpetuity, its more easy communication to light bodies, and its consequent tendency to ascend being proven, this flood of aerial impulsion cannot be denied.

Thus far, then, the causes of phenomena are assigned, and we do not *suppose*, or deal either in imaginary beings, or imaginary actions, but strictly theorize.

I might now show that this flood of aerial impulsion must influence all the planetary motions, but I shall for a moment leave this point without further illustration, in order to explain a circumstance which might be urged as an objection to it.

It may be argued, that, if the Newtonian system be correct in the exclusion of matter from the celestial spaces, there will be no medium by which this impulsion can be effected between the different bodies composing the planetary system.

Now, in answer to this, I would first observe that the absence of matter from the celestial spaces is a mere assumption. This absence of matter, so completely the reverse of whatever we see in nature besides, is assumed merely in order to explain why the planets do not appear to be resisted in their course; but, in obviating this difficulty, it involves the gross absurdity of attraction and other operations pervading a space where there would be nothing to act, and where consequently there could be no operation. It thus, in lieu of a slight difficulty, introduces a great one—even a contradiction and an absurdity. It is surely more consonant with whatever we see

in nature besides, to suppose that matter, however rare it may be, exists there, as elsewhere ; and it seems to me incomparably more rational to suppose that this very matter is an agent in the production and perpetuation of these motions. The phenomenon would thus be explained and no absurdity involved.

But, upon this important subject, it is not with suppositions that I am inclined to be contented. Before I proceed to establish and illustrate the circumstance alluded to in the third paragraph preceding, viz. the influence of aerial impulsion upon the planetary bodies, I shall prove that the planetary spaces cannot possibly be void of matter. Now, we have already seen that all motion ascends, and we also know it to be an infallible axiom in science, that motion never terminates in one body withont being propagated to others. Therefore, motion, in its ascent, cannot be terminated. We also know, that the rarer the particles are, the more certainly will motion be communicated to them, in conformity to the law already established. Hence, it irresistibly follows, that, if the planetary interspaces could be rendered void of matter, they would only be with the greater certainty instantaneously filled by it. If there existed in them no matter to interrupt the progress, and receive the motion of the bodies which had reached the boundaries of the void, these particles, by the acknowledged laws of motion, having no obstacle to their progress, would infallibly percurr that void, and instantly occupy it. To oppose to these arguments authority—the authority of Sir Isaac Newton, or of any other person is in vain, because when Sir Isaac Newton imagined this hypothesis, he neglected to observe that he thereby contradicted a law of motion, the truth of which he himself acknowledged, viz. that motion, if uninterrupted, must proceed: it would indeed have been necessary that he should have shown the falsehood of this law before he could prove the planetary interspaces to be void.

Hence, then, it is shown first, that the planetary interspaces cannot be void ; and secondly, that, if void, they could not, for a moment, remain so.

We have now, therefore, established the perpetuity of motion, its more easy communication to light bodies, its tendency to ascend, its amazing universality (the whole earth presenting one moving superficies), its forming a flood of aerial impulses, and the certainty with which this flood must percurr the planetary interspaces, more especially if they could, for a moment, be rendered void. I shall now, then, proceed more particularly to prove, that this aerial impulsion must influence the planetary

motions, and to place this fact on as firm a basis as the preceding portions of theory.

Now, from the laws of motion already established, it is obvious that this flood of aerial impulses, must, if unopposed by any other force, extend to and powerfully influence the planetary bodies. Indeed, if we could, for a moment, suppose them uninfluenced by any other force, it is incontrovertible that they must implicitly obey this, and be directed by it in their motions; for matter, being equally indifferent to motion and rest, is divested of all power to disobey the impulses which it may receive. But it is, by no means, probable, that this flood of aerial impulsion is uncounteracted. Analogy forces us to conclude, that all the planetary bodies exist under similar circumstances; that the superficies of each is covered by mineral, vegetable and animal beings; that, in each, motion has the same perpetuity, easy communication to light bodies, tendency to ascend, and amazing universality; and that each emits consequently a flood of aerial impulsion which must infallibly percurr the planetary interspaces, more especially if, for a moment, they could be rendered, as supposed by the Newtonians, void. These bodies, I say, being portions of one system, and obedient to similar laws, force us to draw this conclusion. Any other conclusion would be an abandonment of all analogy.

This force of aerial impulsion must, therefore, be, in a greater or less degree, counteracted by other forces of a precisely similar nature.

But, before we proceed to consider the various degrees in which these forces may be counteracted, and the general effects which, under all circumstances, they must produce on each other, and consequently on the bodies from which they emanate, it is necessary to turn the attention to a most important circumstance—that in which they differ from all motions performed near the surface of the earth, or of any other planet. It is this, that all the latter kind of motions are perpetually suffering a diminution of velocity, in consequence of their being retarded by the medium in which they move, and are, therefore, less powerful: but, on the contrary, the former, of which we have been treating, move, not in opposition to, but along with the medium in which they are; suffer from it no diminution; and are therefore more powerful. The great characteristic, then, of the motions of which I am treating is, that, far from being, in any degree, resisted by the medium in which they take place, they are actually produced and continued by it, and must, therefore, be, under all circumstances, incompa-

rably more efficacious than those actions which fall under our observation at the superficies of the earth.

Now, then, however counteracted, these forces cannot possibly be unavailing. For, if such a force be still greater than the planetary impulsion opposing it, a portion, at least, of its momentum must remain entirely unopposed; cannot fail to produce the most powerful effects; and must be implicitly obeyed, in so far as it is greater than that which opposes it: and even that portion of its momentum which is counteracted, cannot possibly be unavailing; it will infallibly repel and counteract as much of the impulsion opposing it, as is less than itself; and thus far even its power must be implicitly obeyed. This last argument is equally applicable to any impulsion which has no portion of its momentum unopposed, and the whole of which is either equal to or less than the impulsion opposing it. It will still repel and counteract as much of that impulsion as is inferior to itself; so far its power must be implicitly obeyed; and so far its effects will be remarkable.

It is, therefore, proven that, in whatever degree these floods of aerial impulsion exist, they must mutually influence each other and the bodies from which they emanate; and as the media accompany the motions which take place in them, even the slightest impulse will be effectual, indeed infinitely more so than, on the superficies of the earth, it can, for instance, be upon the most exquisitely suspended beam; for even in the latter case, there is resistance; in the former, there is none.

It is also further apparent from the facts already established that these bodies must influence each other precisely according to their magnitude, and their contiguity to each other; for, upon this, must implicitly depend the extent and the power of the flood of aerial impulsion which they produce, and consequently the precise degree in which the motions of the less ones are under the control of those of the greater. And here, even at this early stage of the enquiry, I may observe, that, in perfect consistency with this truth, the smaller bodies or planets move around the sun, the satellites around the planets, &c. But it is of little use here to anticipate details.

Thus, then, I have not only established the perpetuity of motion, its more easy communication to light bodies, its tendency to ascend, its amazing universality, (the whole planetary bodies presenting so many moving superficies), its forming a flood of aerial impulses, and the certainty with which this flood must percurr the planetary interspaces, more especially if they could, for a moment, be rendered void; but I have also proven that, in whatever degree these floods of aerial impulsion

exist; they must mutually influence each other, and the bodies from which they emanate; and likewise that these bodies must thus affect each other precisely according to their magnitude and contiguity.

Thus far the causes of phenomena are assigned, and we do not *suppose*, or deal either in imaginary beings or imaginary actions, but strictly theorize. Thus, I establish the great body of my hypothesis; for, although the preceding fundamental part be theory, I term the whole an hypothesis, because the details may, in some instances, be deemed hypothetical.

I. SUBDIVISION. OF PLANETARY ATTRACTION.

It is very important to remark that all the celestial bodies, which are within the scope of our vision, are formed into masses termed nebulæ, and that these again constitute masses of still greater magnitude. Dr Herschell has shown, that the galaxy or milky-way is a great stratum of stars to which our sun and planetary system belong, and has also conjectured, with much probability, that all that sidereal system—that apparently immense stratum, is nothing more than a detached *nebula* in the heavens. It is equally important to observe that this excellent astronomer has uniformly found the spaces surrounding nebulæ almost entirely destitute of stars.

Now, upon the principles already established, these facts are easily explained, and the nature of that which is mysteriously termed planetary attraction becomes apparent. The general impulsion arising from all points of such a nebula as the galaxy, must unavoidably force toward each other the individual bodies composing any less nebula occupying its internal parts, as our planetary system does, and, with wonderful simplicity, the very same general impulsion will keep the spaces surrounding nebulæ free of stars, as Dr Herschell has observed. Analogy must lead us also to conclude, that even the galaxy is a portion of some greater nebula, of which the general impulsion similarly influences it.

Thus, by one single operation, the spaces surrounding nebulæ are rendered free of stars, and, by the very removal of stars from these spaces—by their concentration, these nebulæ are formed. Thus, all the phenomena and more than the phenomena, which can be explained by the assumed mysterious and unintelligible principle of planetary attraction, are explained by the application of simple and easily understood principles which have already been established.

If it be imagined that the influence of the surrounding planetary bodies and fixed stars is insufficient to effect the concentration of our planetary system, it must be remembered that they are obscurer to us on account of the thickness of our atmosphere; that, in many countries, they appear very bright and powerful; and that, from the tops of mountains, they are so in a degree which is inconceivable by those who have not examined them in that situation. Mr Brydone, in his journey to the top of Ætna, found the milky way to resemble a pure flame that shot across the heavens. Of such a mass, completely inveloping our planetary system, the influence cannot fail to be immensely powerful, and amply sufficient to account for all the phenomena which we experience.

The aphelion or point of a planet's orbit, where it is most distant from the sun, and the perihelion where it is nearest—in short, the general eccentricity of a planet's orbit, has doubtless the same intimate connexion with its situation relative to the contiguous planetary bodies, upon the same principles. But, upon the less phenomena commonly ascribed to attraction, I have not here room to dwell.

Thus, then, is planetary attraction very simply acccounted for, without the aid of mysterious agency.

II. SUBDIVISION. OF PLANETARY REPULSION, IMPULSION, AND ROTATION.

Now it must be obvious that the flood of aerial impulsion emanating from each individual planet of such a nebula as our planetary system—an impulsion becoming more perceptible and more powerful the nearer these individual bodies approach each other, will effectually prevent the possibility of their coalescing in consequence of the general impulsion of the greater nebula of which they form a part; for, precisely in proportion as the flood of aerial impulsion of each individual planet of the less nebula increases in consequence of their common approximation, in the same proportion does the general impulsion of the greater nebula inveloping them diminish, in consequence of their gradual concentration toward one point and removal from its influence.

In this manner, then must the flood of aerial impulsion emanating from the sun repel from it the various planets of our system, and, in the same manner, must that emanating from the earth repel the moon, and from Jupiter, Saturn and the Georgium Sidus, their respective satellites.

As the floods of aerial impulsion emanating from these individual bodies is incomparably less than that general impulsion arising from the great nebula by which they are invested, so they operate at a much smaller distance than the latter, and permit the bodies from which they proceed to fall under the influence of limited and peculiar laws.

Thus is planetary repulsion most simply accounted for, without the aid of that mysterious agent which planetary repulsion is generally thought to be.

This, therefore, being established, we have next to examine the more limited and peculiar laws which are thus permitted to operate in consequence of the power of repulsion being less than that described in the last subdivision, and operating at a smaller distance.

Now the sun appears to revolve around its own axis once in 25 days, 14 hours and 8 min. In consequence of this, the flood of aerial impulsion which emanates from it will constantly be impinging, not in a direct, but in an oblique manner against the planetary bodies which are under its influence. Hence, it would follow that these bodies, pressed toward each other by the general impulsion of the nebula investing them, and repelled by their own peculiar and more limited floods of aerial impulsion, but, at the same time, obliquely impinged upon toward what may be termed their posterior side by the great solar impulsion, will inevitably be carried forward in an orbit; for, the two other forces limiting these bodies to a certain distance from the sun, the oblique direction of this impulse must carry them forward in an orbicular form. Hence, all the planets revolve from west to east, or in the order of the signs.

Thus also is planetary impulsion most simply accounted for, without the aid of mysterious agency.

But it is evident, that impulses falling obliquely from a rotating sphere upon another, must unavoidably produce rotation in that sphere also, for they will soonest and most powerfully impinge upon the central or most prominent part of the sphere, and as they fall on it obliquely, laterally, or from behind, it must always move quicker than, and consequently around, its axis.

Thus, too, is planetary rotation most simply accounted for, without the aid of mysterious agency.

This hypothesis also, with equal simplicity, accounts for the distance of the different planets from the sun, their distance from each other, the excentricity of their orbits, and the difference of the times of their revolutions.

With regard to the distance of the different planets from

the sun, it is evident that the greater ought to be most distant; because between the greatest and the sun, the strongest floods of aerial impulsion must subsist, and consistently with this fact, Mercury, Venus and the Earth bear, in their distances, some proportion to their magnitudes. The same observation may, in some measure, be applied to their distance from each other.

It is evident, however, that, considering the number of these bodies, the circumstances of this law must become considerably complex: hence, some smaller planets, as Ceres and Pallas, are held at a greater distance from the sun than their flood of impulsion would otherwise cause, in consequence doubtless of the influence of some of the greater planets operating upon them as well as that of the sun itself: hence, also the various planetary satellites hold their peculiar situation.

With regard to the eccentricity of their orbits, or the deviation from their mean distance from the sun, it is similarly accounted for by the influence of the other planets—an influence which does not operate uniformly in all parts, but produces that which is termed eccentricity, because the planets upon which the influence depends have their own motion, and are not always in the same relation to the planet to whose excentricity we are referring: and this is in perfect conformity to actual facts.

With regard to the difference of the times of their revolutions, it will obviously depend chiefly upon their distance from the sun; but it will not perfectly correspond with this, because it will be modified by the distance of the other planetary bodies and satellites: and this also is in perfect conformity to actual facts. For, the most distant is longest in finishing its course, but with some irregularity from the influence of the contiguous planets.

The same circumstance will also occasion those temporary retardations and accelerations in their course which the various planets and satellites occasionally evidence.

Before concluding this subdivision, I have only, then, to make a few general observations.

The intensity of those powers which are said to act between the masses of bodies, and rather to act at sensible distancs than otherwise, increases with their mass, but diminishes as their distance increases. Hence upon the common hypothesis, it has been concluded that, as the power is proportioned to the number of particles in the attracting bodies, each particle of the attracting bodies must act; but it is said to be inexplicable why the power diminishes as the distance increases, and it

is moreover asserted that this is incompatible with the supposition of general impulsion as the cause of attraction.

Now, by this theory, it is apparent why the force of these attractions, as they are termed, is always proportional to the quantity of matter in bodies, and not less so why it decreases as the square of the distance increases. For the last of these circumstances, indeed, impulsion can alone account, because it is evident that the more remote the object to be impelled is, the less concentrated and powerful will a radiating impulsion be. For it is not to be forgot, that a flood of aerial impulsion which radiates from a centre, as this does, must diverge and become weak in exact proportion to the distance.

The Newtonian system, I may again observe, erroneously excludes the existence of matter from the celestial spaces, in order that it may account for the bodies which move in them not being resisted. The supposition involves the absurdity of action pervading a space where there is nothing to act. And, I confess it appears to me that the phenomena are very simply accounted for, and all absurdity avoided, by the mutual action of the planetary bodies, and of the fluid between, by which not only all resistance is avoided, but the action of the whole even maintained.

By this means, the difficulties of the Cartesian system, such as the disagreement between the planetary motions and the velocities with which the parts of this fluid should move at different distances from the centre of motion; the want of a vivifying force, &c. are all obviated: for here the vivifying force actually exists and all the phenomena accord. Besides, there is here no assumed mysterious principle, as both that hypothesis and that of Le Sage assume,

III. SUBDIVISION. OF GRAVITATION.

According to this hypothesis, gravitation, also, admits of the simplest explanation. I have shown that motion must always be more readily propagated to light bodies, and also that it must ascend, and I have also pointed out and explained the causes of these laws. Now, if it thus be necessary that motion should at once ascend and be propagated to light bodies, it follows inevitably that light bodies must ascend; and if light bodies and, chief among them, the particles of the aeriform fluid must, for these reasons, perpetually ascend, it as inevitably follows that they must perpetually displace heavy ones in the op-

posite direction or downward. Hence, the phenomena which are inseparable from gravitation, even in what is termed the exhausted receiver of the air-pump.

For, there, some of the aerial fluid always remains. If any portion be taken from the air contained in a vessel, the remainder immediately expands and fills the vessel, and no limit to this expansibility has hitherto been discovered, though the experiment with the air-pump is said to have been repeated 3,000,000 of times. Hence, it follows that no experiment performed in what is termed the exhausted receiver of an air-pump, and which requires the total absence of *air*, can be deemed satisfactory. It, on the contrary, appears that, even in that situation as in all others, motion is perpetually ascending, and light bodies are perpetually displacing heavy ones according to the laws already established. Indeed, it must be evident, that the lighter these bodies are, as in the air-pump, the more readily will they displace heavy ones.

But, there are other and not less difficult phenomena of gravitation yet to explain.

Light bodies, in the open air, fall more slowly than heavy ones; but, in the receiver of the air-pump, they fall as quickly. Now, the cause of this is as simple as that of the phenomenon last explained. In the open air, light bodies fall more slowly, precisely because the ascending motion is more readily communicated to light than to heavy bodies, and they are consequently kept longer buoyant or longer in their descent, whereas this motion, being more difficultly communicable to heavy bodies, they are less opposed in their descent, and the less so in proportion to their weight. In the air-pump, on the other hand, light bodies descend more quickly, precisely because, relatively to the medium by which they are there surrounded, they become heavier. The aeriform fluid, being greatly rarified, has undergone a considerable change, and has become still lighter, but the body immersed in it has undergone no change, and is, therefore, in relation to it, heavier. Hence, light bodies in what is termed the exhausted receiver of the air-pump must descend with greater velocity.

Thus it appears that, in the receiver of the air-pump, light bodies descend more quickly, because they are more certainly displaced and less resisted.

Of the acceleration of bodies in their descent, the cause is equally simple. It is obvious, that heavy bodies are every moment receiving innumerable impulses from the light bodies by which they are displaced; and hence their motion must every moment be accelerated.

The attraction of mountains is explicable upon the same principle. Their sides constitute surfaces from which greater or less floods of aerial impulsion arise, and towards which heavy bodies are consequently displaced, and tend in their course.

IV. SUBDIVISION. OF MAGNETISM.

Ferruginous bodies were those in which magnetic properties were first observed. But M. Coulomb of the National Institute, is said to have discovered, that all bodies are more or less endued with magnetic properties.

Now the fact, that bodies are heavier at the poles, can only be accounted for on the hypothesis, that the aerial pressure is there greater; and that they are lighter near the equator, because there the aerial pressure is less. As to the cause of this increased pressure, it is to be remembered, that all the oblique aerial impulses which the earth receives, must take the direction of the poles; for whatever impulse passes close over its surface, in that direction, will be continued in it; whatever impulse strikes its superficies in that direction, will be but slightly deflected from it; and whatever impulse strikes it even in an opposite direction, will also be repelled toward it.

Thus we may conceive, that a sort of aerial flood is perpetually urged toward the poles, and that thereby gravitation is gradually increased till it reaches its maximum in the points remotest from planetary influence.

But these are also the points to which magnetic influence is directed; and we have therefore strong reason to think that it depends upon the aerial flood which I have just described.

That, at the true magnetic equator, the needle does not dip, seems even to prove, that its direction is dependant on this impulsion.

The inclination of the magnetic needle, also, by which it deviates from the horizontal direction; dips with one of its poles toward a pole of the earth; and reaching that pole, would place itself perpendicularly to it, is perfectly conformable with its dependence upon the cause I have assigned for it.

The deviation, likewise, of the magnetic meridian from the real meridian of any place, or the declination of the needle to the east or to the west, would, in perfect consistency with this principle, depend upon the inequalities of the earth's surface, and the consequent inequality of the aerial impulsions;

and, upon the same principle, it would also change in consequence of those temporary derangements of these impulsions which are caused by earthquakes, northern lights, &c.

Now, (if I may venture still further in illustration of this) it is obvious, that the minute particles of this aerial flood will most easily glide along those bodies the superficies of which give least opposition to its particles, and that it will at least *tend* to carry along with it such bodies as, from opposite construction, oppose it. It is obvious, too, that if there were exposed to this flood, a fine body of which the superficies, in one direction, opposed, and, in another, facilitated its passage, that it would speedily be turned in the current, and one of its ends would assume the direction of the pole; and this appears to be the case with the magnet; for, that the sides of that body have this peculiar arrangement of superficial particles, numerous facts lead to conclude. That if a body, likewise, were long exposed in the direction of such a flood, it would be more and more easily passed over in one direction, while by the same act it would be less so in another, is equally clear; and this, too, accords with the phenomena of the magnet. Hence, if a light substance of this kind, were placed between the extremity of such a body as this and the aerial current, it would obviously be turned either from or to the former; and this, also, accords with the phenomena of the magnet. In short, from this close accordance it would appear, that precisely such a body is the magnet.

These last observations are given as quite conjectural. The following, however, seem greatly to support them.

First, with regard to the superficial structure of magnetic bodies, upon which appears to depend both their directive and attractive power, it appears, that when a magnet and piece of steel are rubbed upon each other, and the steel acquires magnetic properties, while those of the magnet are increased, the circumstance is conformable to the dependence of the property on the peculiar arrangement of superficial particles; for their rubbing upon each other can produce only this effect. It appears, also, from the experiments of Cavallo that hammered copper is magnetic, and this too is perfectly conformable with the opinion that the power depends upon this circumstance. The fact that the magnet loses its power by heat is likewise conformable to the dependence of that power upon the order of its superficial particles; for heat can affect it only by altering their arrangement.

Secondly, with regard to magnetic attraction and direction in particular. Corresponding magnetic poles repel each other, because when they are in contact, the superficies of one of the

magnets must be in opposition to and tend to prevent the passage of the fluid, which consequently re-acting upon them, tends to revert one, and so to separate both of them. Whereas different poles appear to attract each other in consequence of the fluid then having its usual and uninterrupted passage along both. That when, in two magnets, the corresponding poles are placed for a long time in contact, they should both become weakened, must arise from its being during that time impossible for the fluid to have its usual passage over them, and from its consequently deranging both those superficies upon which the power depends. And that a piece of iron placed for a long time in an exactly perpendicular direction should become magnetic; is perfectly agreeable to the power's dependence upon impulsion, as, in such a situation, the bar must be most directly acted upon by the descending solar impulsions, and it must also be on that account, that its lower end becomes its north pole; for, if subsequently placed in a horizontal direction, the impulses on our side of the equator must commence by that which was formerly its superior, and terminate by that which was formerly its inferior extremity.

Thus it appears to me that, in the simplest manner, both the peculiar direction and the attraction of the magnet are accounted for.

V. SUBDIVISION. OF THE ATTRACTION OF AGGREGATION.

When two particles of quicksilver which are nearly in contact, appoximate and join, it obviously arises from the simplest cause.

The motion, actuating the aerial particles upon every side, must evidently be much more powerful than that actuating those in the small space between them; thelatter, therefore, yield to the former, and the two bodies consequently coalesce.

They also assume a round form, because their particles are not only such as not to admit among them those of the aerial fluid, but, from their correspondence, entirely to exclude it, and, therefore, when the portion of quicksilver is sufficiently minute and light, the ascending impulsions support and give to it the spherical form.

The adhesion of polished plates takes place upon the same principle.

That such flat surfaces adhere to each other in the receiver of the air-pump, as well as in the open air, instead of being at variance with this principle, is easily explicable upon it; for,

air still exists in the receiver, and, although the plates placed in it require the same counterpoise to detach them, it is chiefly because the counterpoise itself, being also in the same receiver, is also proportionally less pressed upon.

The great adhesion between two small leaden bullets of which the cut surfaces have been twisted upon each other, depends not merely upon aerial pressure, but upon the firmness with which their superficial particles were thus blended through each other.

That different bodies, moreover, adhere with different forces, far from showing, as is generally supposed, that atmospheric pressure has no share in their adhesion, proves exactly the reverse; for, it is obvious, that certain superficies will less accurately coalesce than others; will less accurately exclude from between them the aeriform particles; and will, consequently, less firmly adhere. This reasoning is amply confirmed when it is recollected that the introduction of various substances, as tallow, wax, &c. between these plates, increases the degree of adhesion, which it can do only by more completely excluding the aeriform fluid. These substances are even most effective in this way, if the plates were hot when they were interposed, by which means the intermediate substances are still more accurately applied to all their superficial irregularities, and still more accurately exclude the aerial particles.

These degrees of adhesion, however, will also be perfectly conformable to the affinities of the bodies, exactly because their affinities depend upon the same conformation of particles.

VI. SUBDIVISION. OF CAPILLARY ATTRACTION.

When a drop of water adheres to and spreads over the inferior surface of a smooth plate of glass, so as to form only a thin film, this effect is not, as has been imagined, owing to the attraction of the glass, but to the power mentioned in the last paragraph—the pressure of the air, which forces the aqueous particles into cavities of the glass corresponding to their form. Just so, it is not, in capillary tubes, the attraction of their sides, but the aerial pressure which forces the water into the inequalities of the tube, to which its particles would appear to correspond better than those of the aerial fluid itself. In short, the particles of the water will adhere to those of the glass, in some measure, upon the same principle, that its particles adhere to each other, that is, by the conformity of their structure, and,

from the same cause, those forming the first film covering the superficies of the tube, will carry along a few more particles which will close its aperture.

The law, however, of the ascent of water being always higher as the tube is smaller, has been shown to be unfounded, by the experiments of Dr. Hook, in which tubes as fine as cobwebs being used, the water did not rise so high as might have been expected; its greatest height being only 21 inches above the level of the water in the bason, which is much short of what it ought to have been by the above mentioned law. This shows that the rise of the water is implicitly connected with the relation which its particles bear to the superficial cavities of the tube.

I might have observed that when water does not in this manner adhere to surfaces, as to the leaves of plants, &c. instead of reckoning it a species of repulsion, we are entitled to conclude that it arises from a cause the opposite of that which I have been describing, viz. from the inconformity of the aqueous particles to those of the body upon which it rests, which is indeed confirmed by the fact that a film of air is observable between them and it, and gives to the globules that silvery appearance which, under these circumstances, they alway have.

Here too, however, as in the falling of heavy bodies it will be urged, that all the phenomena take place in the exhausted receiver of an air-pump, and precisely the same answer may be given as in that case. The receiver is still filled with air, for we can only abstract a portion of it.

This explication of capillary attraction has I believe already been attempted, but it was ill supported.—Whatever bodies rise less than water in capillary tubes, must owe their less elevation to their less conformity to the interior surface of the tube, modified also by their gravity.

The correspondence of this explication with other phenomena, such as the maintenance of a column of quicksilver in the tube of the barometer, which we know to be effected by the pressure of the air, is an additional support to it.

VII. SUBDIVISION. OF THE ATTRACTION OF COMPOSITION.

All bodies it is known are full of pores or spaces void of matter, and it has been remarked, that even in gold, which is the heaviest of all bodies, there is perhaps more space than matter. Even water is said to have been forced through it.

Upon the same principle, then, that fluids ascend in capillary tubes, they will evidently pass into the pores of bodies.

Quicksilver, upon this principle, enters the pores of gold, and stains it of a white colour, or those of silver, and forms with it a liquid amalgam. Upon the same principle, of course, water enters the pores of sugar and renders it liquid, as in the last case, and, still on the same principle, aquafortis enters those of copper, and other bodies, and produces similar effects. The simplicity of the operations of nature entitles us to conclude that all these effects, so similar in appearance, take place by one and the same means.

That certain fluids enter and dissolve peculiar bodies and not others, must obviously arise from the particles of some being of such magnitude and form as to enter the pores of certain bodies and not of others. Thus water, not spirit, most easily dissolves sugar, and certain acids, not water, most easily dissolve various metallic bodies.

The liquid is properly said to dissolve the solid, because it is in the former that motion is first apparent. The air, of which the particles seem less adapted to enter such pores, impels the yielding liquid into those of the solid of which the particles are consequently separated from each other and detached, and of course when finely comminuted, become invisible to the eye, and are borne up by and dissolved in the liquid.

Now, if, into such a solution, there be placed a third body, to the pores and particles of which those of the acid, effecting the solution, are still more conformable than to those of the former body, it is evident that the same pressure which occasioned the solution of the first will effect that of the second; the liquid will in a greater or less degree be forced from the pores of the former body to which they are less adapted, and will enter those of the latter, which, minutely comminuted, will now be borne up while the former is precipitated.

Thus, upon the simplest principle, all the phenomena o the attraction of composition are accounted for.

VIII. SUBDIVISION. OF HEAT.

According to the modern theory of chemistry, two substances are necessary to combustion, viz. oxygen and a body termed combustible. The atmospheric oxygen is supposed to consist of a peculiar base and of heat and light. During combustion, the caloric and light of the oxygen are said to be evolved, and its base, combining with the combustible, forms the residue.

This residue is termed incombustible, because, being saturated with oxygen, it cannot combine with more. But, as various facts exist which prove, that oxygen is capable of giving out heat and light not only when liquid, but when solid, and even after combustion, this hypothesis completely falls; and the only manner in which the phenomena are explicable, is on the supposition that heat and light are not component parts of oxygenous gas—are not substances, but motions; the former, of the particles of the combustible body, and the latter, of those of the aeriform fluid surrounding it. The attempt of Brugnatelli to support the falling hypothesis of the French chemists is unsupported by a single fact, and appears to me to be quite unworthy of that philosopher.

As, then, some operations, differing or opposite in every other respect, (as the passage of oxygen from the liquid to the solid state, and also from the solid to the liquid state), and resembling only in one, viz. the existence of rapid motion in the minute particles which are their subject—as these operations produce one and the same effect, namely, heat, it follows with the force of demonstration ,that, as this one effect must have one and the same cause, it cannot possibly arise from that which, in the two cases, is different and even opposite, but must arise from that which in both is the same. The heat, therefore, cannot, in the one of these cases arise, from the passage of oxygen from the liquid to the solid state, and in the other from its passage from the solid to the liquid state; but must arise from that which in the two operations is similar. Now, in the two operations there is nothing similar, but rapid transition; for the very states in which this transition terminates, are opposite:—there is nothing, then, similar in both, but rapid motion. Hence, it irresistibly follows, that motion is the cause of the effect produced—that motion of the minute particles of matter causes heat.

Indeed, that heat is motion, all the modes of its production prove; and the closest analogy subsists between all their phenomena.

Spontaneous combustions, then, must take place where one body is placed in contact with another, possessing such a configuration of particles as to permit the other rapidly to unite with it or with some of its constituent parts.

The sun's light, too, must extinguish fire, precisely because they consist of motion in opposite directions, and of these consequently the weak must be overcome by the strong.

Thus, on the simplest principles, the phenomena of heat

are accounted for, and we proceed in strict conformity with the preceding portion of this hypothesis.

IX. SUBDIVISION. OF LIGHT.

The greater number of philosophers at present consider light as a fluid, of which the extreme subtility renders it impalpable; some also think that it is only a modification of heat,

They are certainly right with regard to this analogy, but wrong in supposing either to be a peculiar matter. As, indeed, I have already shown heat to be motion, it follows that if light be, as is thus rationally conjectured, a modification of it, it also must consist in motion.

But there appears to be something essentially different in light and heat. And I think very little argument will show that light is chiefly that state of separation in the minute particles of bodies which is produced by heat.

Thus, when a body is heated, and gradually inflaming, at last reaches the highest degree of illumination, it first presents a flame which is blue—the colour most remote from white and lightness; gradually it becomes red; then yellow; and, when luminous in the greatest degree, it is white. Thus, heat causes light, and the degree of light produced is strictly dependent on the degree of heat which occasions it.

It is in perfect consistency with this, that Dr. Herschel has found the rays transmitted nearest to the refracting angle of the prism to possess the greatest heating power. For, first, as shown in the Refutation of the Newtonian hypothesis in the last volume of the Archives, the lightest colours are placed toward this angle; secondly, there is a yellow, hitherto unnoticed, placed beyond the red, where the increased heat is discovered; and, thirdly, all the colours stream toward the refracting angle, (as shown by the simple experiment of the spectrum and small piece of whalebone), and carry the heat, or produce and continue motion, in that direction. Thus, Dr. Herschel's experiments are explained, and his conclusions from them completely invalidated.

But light appears further to depend upon the precise state of the separation of particles, to which bodies are reduced by heat; and, in order to prove this, it is only necessary to observe, that the most permanent light is caused by that heat which takes place in the reduction of bodies from the solid to the fluid state, and when the state of fluidity is effected, though its subject may be the most perfect medium of vision and lumin-

ous in the highest degree, heat instantly ceases in it; for, the air continues cool even in the focus of the largest burning glass which in a moment vitrifies particles of opaque matter. Hence, it follows that, while heat is dependent upon the motion during the change, light consists in the state of separation of particles in which that change terminates.

That heat thus consists of motion, and that light thus consists in that separation and arrangement of the particles of bodies which heat effects, and in which it terminates, is beautifully consistent with the fact, that heat and light are least subject to what is termed the attraction of aggregation; for, both motion and that separation and arrangement of particles which it effects, are indeed the only circumstances which cannot be subjected to it, or rather which consist in its destruction.

Minute motion or heat, therefore, throwing the aerial particles into a certain arrangement—undoubtedly into regular successive connexion, no useless pores or vacuities are opposed to the eye, but the flexile medium assumes an arrangement implicitly dependent on the forms of the objects to which the the eye is directed; these objects, therefore, impress the organs by forms which are their own ectypes; and thus they are cognizable to it, or, in common language, are seen, and thus also it is, that vision, like the other senses, is a mere modification of touch.

Thus, in light, there is nothing more than a minute division and separation of the particles of bodies, effected by heat, so that these bodies, reduced to the aeriform state, become a flexible medium which assumes arrangements implicitly dependent on the forms of the objects between which and the eye, it is placed; whence, these objects impress the eye by arrangements of the medium which are their own ectypes, and are thus cognizable to it.

But it remains to be explained why, as during night, such a medium does not give light. Now, upon the same principle, this is as easily explicable. It is obvious, that, without a certain pressure upon the particles of the medium, the powerful tendency of light bodies to ascend, especially when, as during night, freed from the same aerial impulsion, will prevent its transmitting impressions to the eye, and hence, darkness must arise; but, when the aerial impulsion again takes place during the day, the pressure will be restored, tension among the particles will exist, the ectypes of objects will be inevitably formed between them and the eye, and the vision will take place.

It is also obvious, that whatever solid bodies assume that

peculiar arrangement of particles which does not impede the aerial arrangement, they will not easily lose it, and, if plunged in the common medium of vision, will be seen through, as well as it, when, constituting a part of the medium, they will properly obtain the name of transparent. In this circumstance, then, transparency consists, and hence the anterior coats of the eye, and the humours which it contains, have this permanent structure.

But, before proceeding to explain these obvious circumstances with regard to transparency, I ought to have shown why, as aerial impulsion, must upon the whole be nearly equal on all sides of any planetary body, those sides of a planet which are turned from the sun, should not have their medium *similarly* pressed and rendered fit for vision. Now, this difference must arise from some difference in the nature of the impulses received on these two sides. First, then, it appears, that, on the solar side, the impulsion proceeds chiefly from one body, and, on the other side, from many; and, secondly, it appears, that a flood of impulsion from one body, as the sun, must be diverging, and, therefore, tend to support that separation of aerial particles upon which we have just shown light to depend, whereas, on the other side, the flood of impulsion from many bodies widely distributed in every aspect, must be converging to the earth, and, therefore, must tend to destroy that separation and arrangement of aerial particles upon which light depends. Hence, the one will produce light, the other darkness.

Thus, the phenomena and the hypothesis, in every point, accord, and thus the perpetual interchange of motions among the planetary bodies at once illumes and warms them.

Mr. King * seems first to have conjectured, that the sun is an opaque globe like own, and that the luminous matter only floats around it. Every one knows that this has lately received much confirmation from the observations of Dr Herschell, who has pointed out, in connexion with that orb, two orders of clouds, an inferior, resembling our own, and a superior which is luminous. Dr Wilson very sensibly observes, that, considering the dark and unignited state of the sun to exist under this luminous substance, it would seem as if the luminous matter derived not its splendour from any intensity of heat. Upon this subject, however, I need not dwell, as I have already shown that the existence of light does not imply that of heat, but only of a certain separation of particles which heat or motion may previously have effected. That ascending motion

* 'In Morsels of Criticism.'

—that flood of aerial impulsion, which I have described as emanating from all the planetary bodies is sufficient, as already shown, to account of all the phenomena. And, consistently with that hypothesis, it does appear that every planet emits its peculiar light. It appears that, independent of the sun, the moon has some obscure light of her own; having always, in some one place or other, appeared to retain a yellowish or reddish colour in the time of an eclipse. The same is the case with the other planetary bodies.

Now, it is worthy of remark, that the distance at which we are from these bodies is essential to their floods of aerial impulsion producing direct illumination, and also to their transmitting reflected light. Distance, as formerly shown, causes the asperities of bodies to disappear; and renders them relatively to us smoother. For, in order to explain the reason of this, let us suppose an asperity of any body to project one foot from its surface, and the eye to be placed at the distance of a foot further from this asperity, it is evident, that that asperity would appear relatively large, because it extended through one half of the space beween the eye and the object; but, supposing the eye to be removed to the distance of 1000 feet, the asperity would, relatively to the distance, appear less, in the proportion of 1000th part to half of the whole. Thus, the impulsions of a distant object would be more equal, and its superficies relatively smoother, and better calculated to emit equal impulsions and directly to reflect the rays of light which may be incident upon it.

The further, then, within a given extent, that a luminous body is distant, the more parallel and direct will be its rays, the less their angles of incidence, and the greater their light and heat.

Now, this explains not only why we receive more light from the celestial bodies than from the earth, but also why the larger planets must be more distant than the smaller in order to give equal light. We receive most light from the sun, less from the moon, and least from the earth. Now, the superficial particles of the earth's surface are relatively large on account of our little distance; they, therefore, give various directions to the rays of light, and various colours are thus produced on individual objects, which, for the same reason, are cognizable to us. Doubtless, however, the surface of the moon and planetary bodies, when nearly approached, have similar asperities with the earth, which scatter light from all their surfaces and thereby diffuse and render it less apparent. We also, it is worthy of remark, receive least light and heat from the sun when it is nearest us, viz. in winter; and most of both in

summer, when it is most distant. But, the difference of arrangement in the different particles of the planetary superficies, especially when most distant, is relatively to us infinitely small, the difference of their effects is not cognizable, one general result—the relatively direct transmission of the rays and consequent whiteness is produced.

As, however, distance diminishes objects, the further the planets are removed after their surfaces appear perfectly smooth, they become actually less apparent to the human eye, and consequently give less light and heat.

The same effects are also produced by motion, as by distance, and upon the same principle. For, in rapid motion, the asperities of bodies disappear, because the impressions made upon the eye are, in consequence of their permanence, blended, and, relatively to us, their surfaces are rendered smoother and better fitted to give equal impulsions or directly to reflect all the rays of light which may be incident upon them. Whiteness and light consequently result from this reflexion.

Thus, both the distance and the motion of the planetary bodies are essentially useful in the production of light, of which, on the simplest principles, the phenomena are thus accounted for, while, at the same time, we proceed in strict conformity with the preceding portion of this hypothesis.

X. SUBDIVISION. OF FLAME.

Upon this subject little need be said. I have already shown heat to be motion of the minute particles of bodies, and light to be the state of the aeriform fluid induced by these motions. Flame also has already appeared to exist intermediately to these two, and it is, in reality, the combination of bodies and air in these states. Its appearance, which, while it has, in some measure, the opacity of matter, has also much of the character of light, would seem to indicate this, and the curious transition of strongly heated bodies from a flame which is blue to one which is successively red, yellow, white and, at last, luminous in the highest degree and possessing the character of light, proves this. The chemical fact also that both air and bodies are in general necessary to the existence of flame affords an additional proof. In short, it appears that flame is that state of bodies and air, which is intermediate to heat and light.

XI. SUBDIVISION. OF METEORIC, ELECTRIC AND GALVANIC PHENOMENA.

That lightning, electricity and galvanism all render iron magnetic, and produce other effects in common, shows them to be of one and the same nature. The mere appearance, also, of these phenomena, in as far as they are accompanied by flame, proves them to be only more concentrated combinations of the same kind with it. In further illustrating them, therefore, it is immaterial to which of them I limit my observations, their phenomena being the same.

In electricity, it would appear, that the friction seperates the superficial particles, and that an influx of aerial particles consequently takes place, by which means, the light bodies, in its current, are carried along with it.

That redundant or deficient electricity depends much less on the peculiar nature of the body, than on the mechanical structure of its surface, is an additional confirmation of this supposition.

That the power seems to act and to cease alternately must be owing to this, that an undulatory motion of the particles is produced by rubbing, by which means, it alternately receives and excludes the aerial particles, and therefore seems alternately to attract and to repel the light bodies in its current.

That a light body, after being repelled, is not attracted, till it has touched another body, may arise from this, that the electrical body has imparted to it motion by which they are mutually seperated, and that it must communicate this motion to another body before it can be again attracted.

Moisture may destroy electricity by impeding motion, while air does not destroy it, because it consists in a great measure in its motion.

That general heat is produced by electricity must arise from the rapid motion into which the minute particles of bodies are thrown; that light arises from it must depend on the state into which the aerial particles are placed; and that flame arises from it must arise from the combination of air and bodies in these states.

The manner in which heat transmutes non-conductors into conductors, clearly shows that minute motion is the powerful agent in these operations. That general heat, however, does not produce the same effect on the aerial particles as rubbing, may arise from this, that, when heat is thus openly applied, the aerial fluid has, at the same time, ingress, and that, as it

is at once generally applied, no undulation is produced, but a regular and imperceptible expansion, from which the peculiar phenomena cannot be expected to result.

XII. SUBDIVISION. OF COLOURS AND SOUNDS.

Colours are the particular arangements which the superficies of bodies give to the aeriform fluid when illuminated as already described. The data and reasoning on which this is founded, are delivered in the Refutation of the Newtonian hypothesis in the 1st Vol. of the Archives, and from their length cannot be readmitted here.

Sounds consist in the formation of minute vacuua of various kinds in the media which transmit them, and in the instantaneous collapse of the particles forming their sides. The data and reasoning on which this is founded, are delivered in the Theory of Phonics, Hearing, &c. in the same volume, and likewise need not here be repeated.....For those who love authority, I might there, however, in support of this opinion, have adduced that of Boyle. "Though the effects of harmony, discord, and peculiar sounds," says he, "be sometimes very great, not only in human bodies, but, as we shall shew in the following tract, in organical ones too; the whole efficacy of music, and of sounds that are not extraordinary loud and different, seems, as far as it is ascribable to sonorous bodies, to depend upon the different manners of motion whereinto that air is put, that makes the immediate impression on our organs of hearing."

I shall recapitulate the general view of the hypothesis, which I have thus delivered, immediately after the following subdivision.

VI. DIVISION. OF THE INTIMATE STRUCTURE OF BODIES.

This subject is certainly the very first in General Physics; for, as it considers those fundamental circumstances in which even the simplest substances differ from each other, and which constitute, even in the same body, the states of solidity, liquidity or fluidity, it must naturally precede the other portions of that department of science—the remaining greater or more general objects in nature, because all of them must exist either in the solid, liquid or fluid state, and these states may be con-

sidered as affording the characters according to which individual substances may be arranged. I have chosen, however, to introduce it here, because I wished to explain the preceding laws in connexion and without that delay which this subject would have occasioned, and also because I thought my data sufficient without those which I could have derived from it.

In this most important branch of science, which may be denominated Atomology, and which is not only the basis of general physics, but also almost immediately applicable to chemistry, for chemistry is absolutely nothing more than the doctrine of the magnitude, number and arrangement of the elementary particles of bodies—in this important branch, little or nothing has yet been done. With some ancient philosophers, it was indeed a favourite subject, but by them it was considered entirely in a hypothetical manner, and even then not very successfully. Latterly Mr Dalton, much to his honour, has renewed its investigation, but unfortunately with success equally small; for the explanation of the opposite states of water—solidity and fluidity, by one and the same arrangement of particles is utterly improbable, and the supposition that, in the combination of the more simple bodies, particle unites to particle, is, at best, perfectly gratuitons. If, indeed, the particles of certain substances be larger than those of others, it is highly probable that, instead of uniting one to one, they unite two or three to one, and so forth. Thus a greater proportion of hydrogen and a smaller of oxygen, best concur to produce detonation and the formation of water. The attempt, however, in this extremely difficult subject is creditable in the highest degree to Mr. Dalton; though it is probable, that it will require the united labour of many philosophers, and that it will be long before it be thoroughly developed.

To me it appears that this subject ought to be divided into that portion which considers those fundamental circumstances of structure by which even the simplest substances differ from each other, and into that portion which considers those modifications of structure which constitute, even in the same bodies, the states of solidity, liquidity or fluidity.

First, then, as to those fundamental circumstances of structure by which even the simplest substances are distinguished from each other, they do not appear to me to consist in differences in the forms of the particles of matter. With the simplest state of matter, it is highly probable that the simplest form—perfect sphericity is connected. This opinion receives confirmation from the fact that sphericity, both on a large scale as in the planetary bodies, and on a small one, as in throwing

some liquids into a globular form, produces whiteness—the colour possessed by the majority of simpler substances.

Moreover the assumption of a difference of form is unnecessary and, therefore, inconsistent with the simplicity of natural facts and operations. A difference in the magnitude of these particles alone not only accounts for phenomena for which a difference of form would not account, but also accounts for all those phenomena which are fundamental.

Considering matter, then, as one and the same—as constituting a class, there must exist of it at least two subordinate orders, viz. that consisting of particles of some magnitude, or spheres, and that consisting of particles of extreme minuteness and which are still spheres, but which, relatively to the former, may be termed points—I say, on one hand, there must exist of it at least two such orders, because, without some difference, individual bodies could not be characterized; and, on the other, it is unphilosophical to suppose more than two such orders, because, by means of these, every distinction in nature may exist.

For, let us suppose these two states of matter to constitute oxygen and hydrogen—the two most unequivocally simple bodies which are known to us, and to which also all other substances seem every day more and more reducible, it will be found that such a distinction as I have pointed out, will account for their most remarkable qualities, and the most remarkable of the phenomena which result from them.

I cannot better illustrate this than by observing, that, as equal bulks of these two fluids have different weights, exactly so will equal bulks of larger and smaller spherical particles. The agreement is beautiful; for, as a large sphere contains more matter within a given portion of superficies than a small one, the bulk of smaller particles will contain a greater proportion of superficies and consequently more of vaccuum between the particles, than an equal bulk of larger ones, and that bulk which contains most of vacuum and least of solid matter must obviously be lightest. Thus, if, of two portions of matter of equal bulk and weight, one be finely comminuted, it will occupy greater space than that which remains solid, and, therefore, if the former be reduced in bulk to the same size with the latter, it must be diminished in weight. Thus, a given bulk of smaller spheres are lighter than an equal bulk of greater ones. Nor is it to hydrogen and oxygen alone that this reasoning is applicable. All lighter bodies of the simplest kind must consist of minuter particles, for that levity which arises from a

peculiar arrangement of these particles can exist only in the more complex substances.

But it is not alone with regard to levity, that minuter particles evidence the same phenomena with hydrogen, and larger ones, the same with oxygen. Hydrogen also more readily ascends than oxygen, and precisely so do minute particles more readily than larger ones, as has been already shown at considerable length.

Nor is it only in these respects, of levity and a tendency to ascend, that minuter particles thus evidence the same phenomena with hydrogen and larger ones the same with oxygen. Hydrogen is susceptible of inflammation, and inflammation I have shown to consist in motion of the minute particles of matter. I have also shown, that the minuter the particles, the more susceptible are they of motion and therefore of inflammation, and, hence it is, that hydrogen, consisting of the minutest particles, is most susceptible of inflammation.

Moreover that *two* parts of hydrogenous and only *one* of oxygenous gas are necessary to detonation and the formation of water, also corroborates this doctrine.

But it would be endless to trace all the circumstances in which the phenomena, evidenced by minute spherical particles, perfectly and beautifully correspond to those evidenced by hydrogen, and in which the phenomena evidenced by larger spherical particles similarly correspond to those evidenced by oxygen.

Considering, then, this minuteness and magnitude as affording the orders of character in substances, it must now be obvious that the various arrangement of these particles must produce the genera and species. That this is the case, innumerable arguments likewise prove, and of these the following is one of the most striking.

Bodies in the aeriform state—in the state of greatest simplicity, are generally what is termed colourless. Hence, it follows, that colour depends upon something different from the mere size of the particles of which these bodies consist, and by which, in that simple state, they are alone characterized. Bodies, on the contrary in a more compound state, are invariably coloured. Now, I have already shown, that the various colours of bodies are implicitly connected with the arrangement of their minute superficial particles *. Thus, colours, and complexity of structure or peculiar arrangement of particles are closely allied. As thus connected, then, they must either be concomi-

* See Refutation of the Newtonian Hypothesis of Light and Colours, in vol. I. of Archives.

tant effects of the same cause, or one of them must be a cause, and the other effect. But they cannot be concomitant effects of the same cause, because they have no common character, nor does there exist between them any inviolable bond. One of them, therefore, must be a cause, and the other an effect. Now colours cannot possibly be the cause of complexity of structure or peculiar arrangement, because, while on one hand, colours are fleeting and accidental, these are permanent, and, on the other, colours never appear independently of them: colours, therefore, must be their effects.

Thus, we make an additional step with regard to the intimate structure of bodies. As, then, the magnitude or minuteness of the particles of matter afford the characters of the two simple substances, or constitute the orders in character, so peculiar arrangement of these particles affords the characters of the more complex substances, or constitutes what may be termed the inferior subdivisions—the genera and species of character.

We have now to examine, whence arise what may be termed the varieties in the character of substances, or what affords the characters of the three states of solidity, liquidity and fluidity.

As, in the production of these states, heat is the agent, it appears rational first to enquire what this agent, of which we have already ascertained the nature, can effect. Now heat when it reduces bodies to the liquid or fluid state is observed to expand them. Hence, it might be concluded, that these states were produced by the expansion of the particles of matter. But, that heat should expand the very particles of matter supposes, first, that heat is a material substance which we have already shown to be erroneous, and next that even the last particles of matter are penetrable—are entered and expanded by it, which cannot be true; for, if any portion of matter be impenetrable, it is doubtless its minutest particles. Besides, it is not easy to conceive a substance which shall thus enter another and expand it without separating it into minuter portions; for, it is improbable, that that force which shall perforate one of its sides, should cease to act in the centre of the particle—should mysteriously pause there, and merely expand it, instead of passing through and separating it into parts. It is infinitely more consistent, then, both with the opinion that heat is a substance, and with the opinion that it is merely motion of the minute particles of matter, to suppose that it expands bodies only by separating them from each other, not by expanding the particles of which they consist. Whether indeed it be matter or motion, it can operate only in this way.

But, were heat a material substance, it might be supposed

that it was diffused among the particles of matter thus divided. Now I have already shown that it can not be material, because, being produced in the passage of oxygen from the liquid to the solid state, and also by its passage from the solid to the liquid state, were it a material substance, it would be produced by causes which are diametrically opposite, which is absurd. For, as operations thus differing or opposite in every other respect, and resembling only in one, viz. the existence of rapid motion in the minute particles which are their subject—as these operations produce one and the same effect, viz. heat, and, as this one effect must have one and the same cause, it incontrovertibly follows that it cannot possibly arise from that which, in the two cases, is different and even opposite, but must arise from that which, in both, is the same. The heat, therefore, can not, in one of these cases, arise from the passage of oxygen from the liquid to the solid state, and, in the other, from its passage from the solid to the liquid state; but it must arise from that which in the two operations is similar. And, in the two operations, there is nothing similar but rapid transition. Hence it irresistibly follows, that motion is the cause of the effect produced—that motion of the minute particles of matter constitutes heat.

Thus, then, we are led to the conclusion that the degrees of the separation of the particles of matter constitute the states of solidity, liquidity and fluidity.

It is probable, then, that bodies owe their three states to this, that, when solid, all their particles are in contact, and, if they move, they move in a mass; that, when liquid, each particle yields upon another, and motion takes place between them; and that, when fluid, each simple particle of which they are composed is separated, and both it and the mass are in motion.

It must indeed be from this more minute separation of fluid bodies that the same compound is sometimes not reformed, but that some of the particles enter into new combinations, and that they always more readily do so in this state than in any other, and further that either liquidity or fluidity is essential to such effects. Consistently with these principles, when combinations take place among liquids, they are considerably compound, and, when among fluids, much more simple, and indeed, fluid bodies are in general the simplest.

Vapour then evidently arises from the minuteness and consequent lightness of the separated particles which propagate upward—where there is least resistance, the motion communicated to them. And hence it must be, that, when resistance by atmospheric pressure is great, vapour is most slowly formed.

It is obvious that as a body does not ascend immediately upon being merely liquified, it is not then resolved into particles so minute as when vapourized, but that, as these particles only yield upon each other, the aerial pressure merely expands them over any surface upon which they rest.

Of a solid, again, the particles, far from being separated, do not even yield upon each other, but are in closer connection, so that when one is moved, the whole must follow—the whole mass must move together.

The less resistance which the masses of matter give, and their more easy escape from vessels in which they are confined, when in the liquid than in the solid state—and when in the fluid than when in the liquid state, present additional proofs of the truth of this doctrine.

RECAPITULATION.

With the simplest state of matter, then, it is highly probable, that the simplest form—perfect sphericity, is connected.

Considering matter, therefore, as one and the same—as constituting a class, there must exist of it at least two subordinate orders, viz. that consisting of particles of some magnitude or spheres, and that consisting of particles of extreme minuteness and which are still spherical, but which relatively to the former, may be termed points.—I say there must exist of it at least two such orders, because, on one hand, without some difference, individual bodies could not be characterized; and, on the other, it is unphilosophical to suppose more than two such orders, because from these, every distinction in nature may arise.

For supposing these two states of matter to constitute oxigen and hydrogen, such a distinction as I have pointed out will account for their most remarkable qualities, and the most remarkable of the phenomena which result from them.

Thus, as equal bulks of these two fluids have different weights, exactly so will equal bulks of larger and smaller spherical particles; for, as a large sphere contains more matter within a given portion of superficies than a small one, the bulk of smaller particles will contain a greater proportion of superficies, and consequently more of vacuum between the particles, than an equal bulk of larger ones, and that bulk which contains most of vacuum and least of solid matter must obviously be lightest. Thus a given bulk of smaller spheres are lighter than an equal bulk of greater ones. Nor is it to hydrogen and

oxygen alone that this reasoning is applicable: all lighter bodies of the simplest kind must consist of minuter particles, for that levity which arises from a peculiar arrangement of these particles can exist only in the more complex substances.

But it is not alone with regard to levity that minuter particles evidence the same phenomena with hydrogen, and larger ones the same with oxygen. Hydrogen also more readily ascends than oxygen, and precisely so do minute particles more readily than large ones, as has been already shown at considerable length.

Nor is it only, in these respects of levity and a tendency to ascend, that minuter particles thus evidence the same phenomena with hydrogen, and larger ones the same with oxygen. Hydrogen is susceptible of inflammation, and inflammation I have shown to consist in motion of the minute particles of matter. But I have also shown that the minuter the particles, the more susceptible are they of motion and therefore of inflammation, and hence hydrogen, consisting of the minutest particles, is most susceptible of inflammation.

Considering, then, this minuteness and magnitude as affording the orders of character in matter, it must now be obvious that the various arrangements of these particles must produce the genera and species. That this is the case, innumerable arguments likewise prove, and of these the following is one of the most striking.

Bodies in the aeriform state—in the state of greatest simplicity, are generally what is termed colourless. Hence it follows, that colour depends upon something different from the mere size of the particles of which these bodies consist, and by which, in that simple state, they are alone characterized. Bodies, on the contrary, in a more compound state are invariably coloured. Now I have already shown, that the various colours of bodies are implicitly connected with the arrangement of their minute superficial particles. Thus colours and complexity of structure or peculiar arrangement of particles are closely allied. As thus connected, then, they must either be concomitant effects of the same cause, or one of them must be a cause, and the other an effect. But they cannot be concomitant effects of the same cause, because they have no common character, nor does there exist between them any inviolable bond. One of them, therefore, must be a cause, and the other an effect. Now colours cannot possibly be the cause of complexity of structure or peculiar arrangement, because, while, on one hand, colours are fleeting and accidental, these are permanent; and, on the other, colours never

appear independently of them: colours therefore must be their effects.

As, then, the magnitude or minuteness of the particles of matter afford the characters of the two simple substances, or constitute the orders in character; so peculiar arrangement of these particles affords the characters of the more complex substances, or constitutes what may be termed the inferior subdivisions—the genera and species of character.

Numerous phenomena also lead to the conclusion, that the degree of the separation of the particles of matter constitute the states of solidity, liquidity, and fluidity.

So much, then, as to the intimate structure of bodies....In the commencement of the paper, I have not only established the perpetuity of motion in bodies thus composed; its more easy communication to light bodies, its tendency to ascend, its amazing universality (the whole planetary bodies presenting so many moving superficies) its forming a flood of aerial impulses, and the certainty with which this flood must percurr the planetary interspaces, more especially if they could for a moment be rendered void; but I have also proven, that, in whatever degree these floods of aerial impulsion exist, they must mutually influence each other, and the bodies from which they emanate, and likewise that these bodies must thus affect each other precisely according to their magnitude and contiguity.

It has been seen that the general impulsion arising from all points of such a nebula as the galaxy, must unavoidably force toward each other the individual bodies composing any less nebula occupying its internal parts, as our planetary system does, and, with wonderful simplicity, the very same general impulsion will keep the spaces surrounding nebulæ free of stars, as Dr. Herschell has observed....Thus is planetary attraction accounted for.

It has also been seen that the flood of aerial impulsion emanating from each individual planet of such a nebula as our planetary system—an impulsion becoming more perceptible and more powerful the nearer these individual bodies approach each other; will effectually prevent the possibility of their coalescing in consequence of the general impulsion of the greater nebula of which they form a part; for precisely in proportion as the flood of aerial impulsion of each individual planet of the less nebula increases, in consequence of their common approximation, in the same proportion, does the general impulsion of the greater nebula enveloping them diminish in conse-

quence of their gradual concentration towards one point and their removal from its influence.

In this manner, then, must the flood of aerial impulsion emanating from the sun repel from it the various planets of our system, and in the same manner must that emanating from the earth repel the moon, and from Jupiter, Saturn, and the Georgium Sidus, their respective satellites.

As, also, the floods of aerial impulsion, emanating from these individual bodies, is incomparably less than that general impulsion arising from the great nebula by which they are invested; so, they operate at a much smaller distance than the later, and permit the bodies from which they proceed to fall under the influence of limited and peculiar laws....Thus is planetary repulsion accounted for.

The sun, then, appears to revolve around its own axis once in 25 or 26 days, and in consequence of this, the flood of aerial impulsion which emanates from it will constantly be impinging, not in a direct, but in an oblique manner, against the planetary bodies which are under its influence. Hence, it would follow that these bodies, pressed towards each other by the general impulsion of the nebula investing them, and repelled by their own peculiar and more limited floods of aerial impulsion, but, at the same time, obliquely impinged upon, toward what may be termed their posterior side, by the great solar impulsion, will inevitably be carried forward in an orbit; for, the two other forces limiting these bodies to a certain distance from the sun, the oblique direction of this impulse must carry them forward in an orbicular form. Hence all the planets revolve from west to east in the order of the signs....Thus is planetary impulsion accounted for.

But it is evident, that impulses falling obliquely from a rotating sphere upon another, must unavoidably produce rotation in that sphere also, for they will soonest and most powerfully impinge upon the central or most prominent part of the sphere, and as they fall on it obliquely, laterally or from behind, it must always move quicker than, and consequently around, its axis....Thus is planetary rotation accounted for.

The Newtonian System erroneously excludes the existence of matter from the celestial spaces, in order that it may account for the bodies which move in them not being resisted. The supposition involves the absurdity of action pervading a space where there is nothing to act. And it appears to me that the phenomena are very simply accounted for and all absurdity avoided by the mutual action of the planetary bodies,

and of the fluid between, by which not only all resistence is avoided, but the action of the whole even maintained.

By this means, the difficulties of the Cartesian system, such as the disagreement between the planetary motions and the velocities with which the parts of this fluid should move at different distances from the center of motion; the want of a vivifying force, &c. are all obviated; for here the vivifying force actually exists, and all the phenomena accord. Besides, there is here no mysterious principle, as both that hypothesis, and that of Le Sage assume.

According to this hypothesis, gravitation, also, admits of the simplest explanation. I have shown that motion must always be more readily propagated to light bodies, and also that it must ascend, and I have likewise pointed out and explained the causes of these laws. Now, if it thus be necessary that motion should at once ascend and be propagated to light bodies, it follows inevitably that light bodies must ascend; and if light bodies and, chief among them, the particles of the aeriform fluid, for these reasons, perpetually ascend, it as inevitably follows that they must perpetually displace heavy ones in the opposite direction or downward. Hence the phenomena which are inseparable from gravitation even in what is termed the exhausted receiver of the air-pump; for there some of the aerial fluid always remains.

Hence, too, however, it follows that no experiments performed in what is termed the exhausted receiver of an air-pump, and which require the total absence of air can be deemed satisfactory. It, on the contrary, appears that, even in that situation, as in all others, motion is perpetually ascending, and light bodies are perpetually displacing heavy ones according to the laws already established. Indeed it must be evident, that the lighter these bodies are, as in the air-pump, the more readily will they displace heavy ones.

Of the acceleration of bodies in their descent, the cause is equally simple. It is obvious that heavy bodies are every moment receiving innumerable impulses from the light bodies by which they are displaced, and hence their motion must every moment be accelerated....Thus is gravitation accounted for.

The fact that bodies are heavier at the poles can only be accounted for on the hypothesis that the aerial pressure is there greater, and that they are lighter near the equator, because there the aerial pressure is less. As to the cause of this increased pressure, it is to be remembered that all the oblique aerial impulses which the earth receives must take the

direction of the poles; for, whatever impulse passes close over its surface in that direction will be continued in it; whatever impulse strikes its superficies in that direction, will be but slightly deflected from it, and whatever impulse strikes it even in an opposite direction, will also be repelled toward it. Thus we may conceive that a sort of aerial flood is perpetually urged toward the poles, and that gravitation is thereby gradually increased.

Now, that, at the true magnetic equator, the needle does not dip; that, at other places, it does dip; and that inequalities of the earth's surface, and consequent inequalities of the aerial impulsions, or derangements of them from various other causes, produce its declination to the east or to the west—these circumstances seem to prove that this aerial impulsion is the cause of magnetic phenomena.

It is obvious, that the minute particles of this aerial flood will most easily glide along those bodies the superficies of which give least opposition to its particles, and that it will at least tend to carry along with it such bodies as, from opposite construction, oppose it. It is obvious, too, that if there were exposed to this flood a fine body of which the superficies, in one direction, opposed, and, in another, facilitated its passage, that it would speedily be turned in the current and one of its ends would assume the direction of the pole; and this appears to be the case with the magnet; for that the sides of that body have this peculiar arrangement of superficial particles, numerous facts lead to conclude. That if a body, likewise, were long exposed in the course of such a flood, it would be more and more easily passed over in one direction, while, by the same act, its sides would be less so in another, is equally clear; and this, too, accords with the phenomena of the magnet. Hence if a light substance of this kind, were placed between the extremity of such a body as this and the aerial current, it would obviously be turned either from or to the former; and this, also, accords with the phenomena of the magnet. In short, from this close accordance it would appear that precisely such a body is the magnet....Thus are the peculiar direction and the attraction of the magnet accounted for.

When two particles, also, of quick silver which are nearly in contact approximate and join, it obviously arises from the simplest cause. The motions actuating the aerial particles upon every side, must evidently be much more powerful than that actuating the small space between them; the latter, therefore, yield to the former and the two bodies consequently coalesce. The adhesion of polished plates takes place upon

the same principle....Thus is aggregation likewise accounte for.

When a drop of water also adheres to and spreads over the inferior surface of a smooth plate of glass, so as to form only a thin film, this effect is owing to the power mentioned in the last paragraph—the pressure of the air; which forces the aqueous particles into cavities of the glass corresponding to their form. Just so it is not, in capillary tubes, the attraction of their sides, but the aerial pressure which forces the water into the inequalities of the tube to which its particles would appear to correspond better than those of the aerial fluid itself. In short, the particles of water adhere to those of the glass, in some measure, upon the same principle, that its particles adhere to each other, that is by the conformity of their structure, and, from the same cause, those forming the first film covering the superficies of the tube, will carry along a few more particles which will close its aperture.

Here too, however, as in the falling of heavy bodies, &c. it will be urged that all the phenomena take place in the exhausted receiver of an air-pump; and precisely the same answer may be given as in that case. The receiver is still filled with air; for we can only abstract a portion of it....Thus also is capillary attraction accounted for.

All bodies, it is, moreover, known, are full of pores or spaces void of matter, and, it has been remarked, that even in gold, which is the heaviest of all bodies, there is perhaps more space than matter. Even water is said to have been forced through them. Upon the same principle, then, that fluids ascend in capillary tubes, they will evidently pass into the pores of bodies.

Quicksilver, upon this principle, enters the pores of gold, and stains it of a white colour, or those of silver, and forms with it a liquid amalgam. Upon the same principle, of course, water enters the pores of sugar and renders it liquid, as in the last case, and still on the same principle, aquafortis enters those of copper and other bodies, and produces similar effects. The simplicity of the operations of nature entitles us to conclude, that all these effects, so similar in appearance, take place by one and the same means.

That certain fluids enter and dissolve peculiar bodies and not others, must obviously arise from the particles of some being of such magnitude and form as to enter the pores of some and not of others. Thus water, not spirit, most easily dissolves sugar, and certain acids, not water, most easily dissolve various metallic bodies.

The liquid is properly said to dissolve the solid, because it is in the former that motion is first apparent. The air, of which the particles seem less adapted to enter such pores, impels the yielding liquid into those of the solid of which the particles are consequently separated from each other and detached, and of course, when finely comminuted, they become invisible to the eye, and are borne up by and dissolved in the liquid.

Now, if, into such a solution, a third body be placed, to the pores and particles of which those of the acid, effecting the solution, are still more conformable than to those of the former body, it is evident that the same pressure which occasioned the solution of the first, will effect that of the second; the liquid will consequently, in a greater or less degree, be forced from the pores of the former body, and will enter those of the latter, which, minutely comminuted, will now be borne up while the former is precipitated.

Thus, the attraction of composition is accounted for.

That heat is motion, all the modes of its production prove, and the closest analogy subsists between all their phenomena.

For as some operations, differing or opposite in every other respect, (as the passage of oxygen from the liquid to the solid state, and vice versa,) and resembling only in one, viz. the existence of rapid motion in the minute particles which are their subject—as these operations produce one and the same effect, viz. heat, it follows, that, as this one effect must have one and the same cause, it cannot possibly arise from that which, in the two cases, is different, and even opposite, but must arise from that which, in both, is the same. The heat, therefore, cannot in the one of these cases, arise from the passage of oxygen from the liquid to the solid state, and, in the other, from its passage from the solid to the liquid state, but must arise from that which, in the two operations, is similar. Now, in the two operations, there is nothing similar, but rapid transition; for the very states in which this transition terminates are opposite: —there is nothing, then, similar in both, but rapid motion. Hence, it irresistibly follows, that motion is the cause of the effect produced—that motion of the minute particles of matter causes heat....Thus, the phenomena of heat are accounted for.

Very little argument will show that light is chiefly that state of separation in the minute particles of bodies which is produced by heat.

Thus, when a body is heated, and gradually inflaming, at last, reaches the highest degree of illumination, it first presents a flame which is blue—the colour most remote from white and lightness; gradually it becomes red; then yellow; and, when

luminous in the greatest degree, it is white. Thus, heat causes light, and the degree of light produced is strictly dependent on the degree of heat which occasions it.

But it appears further to depend upon the precise state of the separation of particles, to which bodies are reduced by heat, and, in order to prove this, it is only necessary to observe that the most permanent light is caused by that heat which takes place in the reduction of bodies from the solid to the fluid state, and when the state of fluidity is effected, though its subject may be the most perfect medium of vision and luminous in the highest degree, heat instantly ceases in it; for, the air continues cool even in the focus of the largest burning glass, which, in a moment, vitrifies particles of opaque matter. Hence, it follows that while heat is dependent upon the motion during the change, light consists in the state of separation of particles in which that change terminates.

Minute motion or heat, therefore, throwing the aerial particles into a certain arrangement—undoubtedly into regular successive connexion, no useless pores or vacuities are opposed to the eye, but the flexile medium assumes an arrangement implicitly dependent on the forms of the objects to which he eye is directed; these objects, therefore, impress the organ by forms which are there own ectypes, and thus they are cognisable to it, or, in common language, are seen, and thus it is that vision, like the other senses, is a mere modification of touch.

Thus in light there is nothing more than a minute division and separation of the particles of bodies effected by heat, so that these bodies, reduced to the aeriform state, become a flexile medium which assumes arrangements implicitly dependent on the forms of the objects between which and the eye, it is placed, whence these objects impress the eye by arrangements of the medium which are their own ectypes, and are thus cognizable to it...Thus the phenomena of light are accounted for.

Upon the subject of flame little need be said. I have already shown heat to be motion of the minute particles of bodies, and light to be the state of the aeriform fluid induced by these motions. Flame also has already appeared to exist intermediately to these two, and it is in reality the combination of bodies and air in these states. Its appearance which, while it has in some measure, the opacity of matter, has also much of the character of light, would seem to indicate this, and the curious transition of strongly heated bodies from a flame which is blue to one which is successively red, yellow, white and at

last luminous, in the highest degree and possessing the character of light, also proves it. The chemical fact, also, that both air and bodies are in general necessary to the existence of flame affords an additional proof of this...In short, it appears that flame is that state of matter which is intermediate to heat and light.

The mere appearence of meteoric, electrical and galvanic phenomena in as far as they are accompanied by flame proves them to be only mere concentrated combinations of the same kind with it.

In electricity, it would appear that the friction separates the superficial particles, and that an inhux of aerial particles consequently takes place, by which means, the light bodies, in its current, are carried along with it.

That the power seems to act and to cease alternately must be owing to this that an undulatory motion of the particles is produced by rubbing, by which means, it receives and excludes the aerial particles, and therefore seems alternately to attract and to repel the light bodies in its current.

That heat is produced by electricity must arise from the rapid motion into which the minute particles of bodies are thrown ; that light arises from it must depend on the state into which the aerial particles are thrown ; and that flame arises from it, must arise from the combination of air and bodies in those states.

Colours are the particular arrangements which the superficies of bodies give to the aeriform fluid when illuminated as already described.

Sounds consist in the formation of minute vacua of various kinds in the media which transmit them and in the instantaneous collapse of the particles forming the sides of these vacua.

PATENT OFFICE LIBRARY.

THIRD DEPARTMENT OF SCIENCE, OR PARTICULAR PHYSICS.

CHEMISTRY.

ON THE EXISTENCE OF OXYGEN IN AMMONIA.

BY DR HENRY.

A part of a letter from Dr Henry to Mr Davy, on oxygen of ammonia when exposed to electrization, was lately read to the Royal Society. By some recent experiments, Dr H. has ascertained, that in decomposing the ammonia, some oxygen was admitted in the process, and that consequently what was found as the result of his former experiments was not derived from the ammonia by electrization, but from the agents employed. The final result, however, of his experiments and reasoning tended to prove that ammonia, as Mr Davy originally concluded, is composed of oxygen, hydrogen and nitrogen.

In a subsequent paper, the result of the author's experiments led him to perceive some errors in those of his preceding one, and to conclude that the oxygen which he had disengaged from ammonia by electrization was derived from other bodies, and not from the ammonia; consequently that ammonia, could not yet be considered as an oxide.

Mr Davy read some remarks on Dr Henry's experiments which tended to prove that the composition of ammonia cannot be ascertained till the nature of nitrogen is determined. Dr H. thought the proportion of hydrogen in ammonia, as determined by Mr Davy, rather low, and estimated it at 72 hydrogen and 28 nitrogen, instead of 74 hydrogen and 26

nitrogen; but Mr D. having repeated his experiments, found them very nearly correct, and took 73—27 as the truth.

ON THE ACTION OF POTASSIUM ON AMMONIA.

BY HUMPHRY DAVY ESQ.

On the 2d of February, an interesting paper by Mr Davy was read to the Royal Society, giving an account of various experiments on the action of potassium on ammonia, from which it appears, that a considerable quantity of nitrogen can be made to disappear, and can be regenerated. When it disappears, nothing is obtained in its place but oxygen and hydrogen; and when it is *formed*, its elementary matter is furnished by water.

There seem to be, at present, only two modes of explaining these extraordinary and entirely unlooked for results: *i. s.* that nitrogen is either a compound of hydrogen and oxygen,—or that hydrogen, nitrogen, ammonia, water, and the nitrous compound, all contain the same elementary matter, and that their different forms depend upon different electrical states. The paper concluded by stating that the author was still pursuing this inquiry, so intimately connected with the whole arrangements of chemistry and meteorolgy.

DISCOVERY OF A NEW METAL.

BY DR JAHN.

Dr Jahn conceives, that he has found a new volatile and acidifiable metal in the grey ore of manganese from Saxony. He obtained it by distilling the ore with sulphuric acid. The volatile metallic acid combines with a weak solution of potash put into the receiver, and tinges it crimson. From this red liquor, gallic acid, or infusion of galls, throws down a chesnut brown precipitate. Prussiates immediately change the red colour to a fine lemon yellow, but without any precipitation. The carbonates do not precipitate the red solution; but,

if it be heated with a little alcohol, the red colour changes to a green, a smell of ether is given out, and then the carbonates throw down a brown oxide, which is soluble in muriatic acid.

OF ANOTHER NEW METAL.

A German chemist is said to have discovered another new metal among the grains of platina, to which he gives the name of *vestium*.

OF THE INDENTITY OF COLUMBIUM AND TANTALIUM.

BY DR WOLLASTON.

On the 8th June, Dr Wollaston read a paper to the Royal Society, proving the indentity of columbium and tantalium, the former discovered by Mr Hatchett, the latter by the Swedish chemist Ekeberg. Dr W. procured some grains of the original specimens from the British Museum, and from Mr Hatchett; and notwithstanding the smallness of the quantity, he succeeded in proving them to be radically the same metal.

ON THE SPONTANEOUS IGNITION OF CHARCOAL.

BY B. G. SAGE, MEMBER OF THE INSTITUTE.

Mr de Caussigni appears to have been the first who observed, that charcoal was capable of being set on fire by the pressure of millstones.

Mr Robin, commissary of the powder mills of Essone, has given an account in the Annales de Chime, No. 35, p. 93, of the spontaneous inflammation of charcoal from the black berry bearing alder, that took place the 23d of May, 1801,

in the box of the bolter, into which it had been sifted. This charcoal, made two days before, had peen ground in the mill without shewing any signs of ignition. The coarse powder, that remained in the bolter, experienced no alteration. The light undulating flame, unextinguishable by water, that appeared on the surface of the sifted charcoal, was of the nature of inflammable gas, which is equally unextinguishable.

The moisture of the atmosphere, of which fresh made charcoal is very greedy, appears to me to have concurred in the developement of the inflammable gas, and the combustion of the charcoal.

It has been observed, that charcoal powdered and laid in large heaps heats strongly.

Alder charcoal has been seen to take fire in the warehonses, in which it has been stored.

About thirty years ago I saw the roof of one of the low wings of the Mint set on fire by the spontaneous combustion of a large quantity of charcoal, that had been laid in the garrets.

Mr Malet, commissary of gunpowder at Pontailler, near Dijon, has seen charcoal take fire under the pestle. He also found, that when pieces of salt-petre and brimstone were put into the charcoal mortar, the explosion took place between the fifth and sixth strokes of the pestle. The weight of the pestles is 80 pounds each, half of this belonging to the box of rounded bell metal, in which they terminate. The pestles are raised only one foot, and make 45 strokes in a minute.

In consequence of the precantion now taken, to pound the charcoal, brimstone, and salt-petre seperately, no explosions take place; and time is gained in the fabrication, since the paste is made in eight hours, that formerly required four and twenty.

Every wooden mortar contains twenty pounds of the mixture, to which two pounds of water are added gradually. The paste is first corned: it is then glazed, that is the corns are rounded, by subjecting them to the rotatory motion of a barrel, through which an axis passes: and lastly it is dried in the sun, or in a kind of stove.

Experience has shown, that brimstone is not essential to the preparation of gunpowder; but that which is made without it falls to powder in the air, and will not bear carriage. There is reason to believe, that the brimstone forms a coat on the surface of the powder, and prevents the charcoal from attracting the moisture of the air.

The goodness of the powder depends on the excellence of the charcoal; and there is but one mode of obtaining this in perfection, which is distillation in close vessels, as practised by the English.

The charcoal of our powder manufactories is at present prepared in pots, where the wood receives the immediate action of the air, which occasions the charcoal to undergo a particular alteration.

THEORY OF THE DETONATION AND EXPLOSION OF GUNPOWDER.

BY THE SAME*.

These two phenomena, which take place simultaneously, arise from different causes. The detonation is the noise produced by the combustion of two parts of inflammable and one of oxigen gas.

The explosion, or discharge, is produced by the water of the nitre, and that which results from the decomposition of the two gasses, which, being expanded by the fire, occupies fourteen thousand times the space it did before; and acts in the same manner as compressed air, to which its elasticity is restored, and the explosive effect of which is produced without detonation.

The inflammation of gunpowder by means of a spark arises from the ignition of the nitre and brimstone.

The inflammable gas is produced by the decomposition of the charcoal*; and the oxigen gas arises from part of the nitre, which is decomposed by the fire.

After the explosion of gunpowder, we find the inside of the gunbarrel coated with a mixture of alkaline sulphuret and charcoal not decomposed. This alkaline mixture attracts the moisture of the air, add forms a greasy coating within the

* Ibid. p. 425.

* In France charcoal of alder, poplar, willow, &c. is always used for making gunpowder. The intensity of the fire produced by such charcoal is less than of that from harder wood. The former, being more porous, requires more care in charring than the latter; and they cannot be said to be in the state of charcoal, unless they have been distilled; for when prepared by smothering the fire, there is always a portion reduced to the state of ashes [*braise.*]

barrel. If it be loaded in this state, part of the powder adheres to the sides of the barrel; and on discharging the piece, it catches, and produces what is termed *hanging fire*. The barrel of a fowling piece therefore should never be used a second day without cleaning.

ON THE INGENEOUS FUSION OF BARYTES*.

BY M. GEHLEN, IN A LETTER TO M. DISCOTILS.

It appears to me, that the French chemists are yet unacquainted with the fusibility of pure barytes by fire, which Mr Bucholz discovered, and described in 1800, in the 2d number of his *Beitraege zur Erweiterung und Berichtigung der Chimie*.

If pure barytes be heated in a platina or silver crucible, it liquefies in its water of crystallization. After this water is evaporated, it enters into fusion at a bright cherry red heat, and flows like an oil. On cooling, it becomes a gray mass, radiated in its fracture, which, when powdered, redissolves in water, heating more strongly than lime, and recrystallizes in cooling.

Mr Bucholz, having hitherto prepared his pure barytes only in Pelletier's method, did not know by experience, that barytes did not melt when it has been prepared by the decomposition of the nitrate by fire; which it might have been expected to do, but which I have never seen take place, even with the strongest heat. Mr Bucholz and I have made some experiments; to ascertain the cause of this; but we have not yet attained our object. Neither an excess of carbonic acid, nor the solution of part of the substance of the crucible, appears to be the occasion of this difference, since, on dissolving the residuum of the decomposition of the nitrate in water, very little insoluble matter remains in proportion to the quantity of barytes; and, on adding this insoluble matter to pure barytes in much larger proportion, the latter is not prevented from entering into fusion.

We know not whether the previous crystallization of barytes be necessary to the fusion, and consequently whether

* Annales de Chemie, Vol. LXIV. p. 168.

water do not act some part in it. This might be solved, by decomposing the nitrate in a crucible of some material not acted upon either by the nitrate or barytes. We made our experiment in a silver crucible, but obtained no decisive result, on account of the large quantity of silver, which the nitrate detached from the the crucible by cohesion. As we have not a crucible of gold, or of platina, we cannot pursue our experiment. These observations, if inserted in your Annals, may perhaps tend to an elucidation of the subject.

NOTE BY MR DESCOTILS.

The French chemists have long known the igneous fusion of barytes, and it was with barytes thus fused, that Mr Thenard determined the proportions of sulphate of barytes, which he gave in his Memoir on Antimony, published in 1800. It was likewise with fused barytes, that Mr Berthollet has since determined the proportions of the principles of the same salt. As to the difference in fusibility of crystallized barytes and that which is obtained from the decomposition of the nitrate, Mr Berthollet will make known the cause in a paper, which will be inserted in the 2d volume of the *Memoires d' Arcueil*. His experiments relating to barytes were already finished, when I received Mr Gehlen's letter; and they had given occasion to a series of researches, that are now concluded. In Mr Berthollet's paper it will appear, that water is the cause of the fusibility of barytes, as the two celebrated chemists of Erfurt have suspected; and that it is likewise the cause of the difference of the proportions of the principles of sulphate of barytes given by the chemists, who have attempted at different times to determine its composition.

ON THE EXISTENCE OF OXYGEN IN PRUSSIC ACID.

BY MR R. PORRETT JUNR.

At a late meeting of the Society of Arts, a communication from Mr Porrett was read, announcing that he succeeded

in obtaining prussous (or sub-prussic) acid—an acid differing from prussic, as sulphurous does from sulphuric acid, by containing less oxygen. It is a most delicate test of the presence of silver in solution, and has the singular property of precipitating iron of a red colour. It has completely proved the presence of oxygen in prussic acid; as by deoxygenating the latter it becomes prussous acid; and on adding oxygen, it is again capable of affording a blue precipitate of iron.

ACCOUNT OF THE DECOMPOSITION AND RECOMPOSITION OF BORACIC ACID.

BY MESSRS. GAY LUSSAC AND THENARD*.

On the 21st of June last we announced in a note read at the Institute, and we published in the *Bulletin de la Société Philomatique* for July, that by treating the fluoric and boracic acids with the metal of potash we obtained results, which could only be explained by admitting these acids to be compounds of a combustible substance and oxygen. However, as we had not recomposed them, we added, that we did not give this composition as completely demonstrated. Since that time we have continued and varied our researches, and are now able to assert, that the composition of the boracic acid is no longer problematical. In fact, we can decompose this acid and recompose it at pleasure.

To decompose it, we put equal parts of the metal and very pure and well vitrified boracic acid into a copper tube, to which a curved glass tube is fitted. The tube of copper is placed in a small furnace, and the extremity of the glass tube in a jar filled with mercury. The apparatus being thus arranged, the copper tube is heated gradually, till it is slightly red hot. In this state it is kept for some minutes. The operation being then finished, it is cooled, and the matter taken out. The following are the phenomena observed in this experiment.

When the temperature is about 150° [302° F.], the mixture on a sudden grows highly red, as may be seen in a strik-

* Journal de Physique for November 1808, Vol LXVII, p 393.

ing manner by using a glass tube. There is vnee so much heat produced, that the glass tube partly melts, and sometimes breaks, and the air of the vessels is almost always expelled with force. From the beginning of the experiment to the end, nothing is disengaged but atomospheric air, and a few bubbles of hydrogen gas, not answering to a fiftieth part of what the metal employed would give out by means of water. All the metal constantly disappears in decomposing part of the boracic acid; and the two subtsances are converted by their reciprocal action into an olive gray matter, which is a mixture of potash and the radical of the boracic acid. This mixture is extracted from the tube by pouring in water, and heating it gently; and the boracic radical is separated by repeated washing with warm or cold water. Before this washing it is advisable to saturate the alkali contained in the mixture with muriatic acid: for it appears, that the boracic radical can become oxided, and then dissolve in the alkali, to which it gives a very deep colour. What does not dissolve is the radical itself, which possesses the following properties.

It is of a greenish brown colour, fixed and insoluble in water. It has no taste; and no action on infusion of litmus or sirup of violets, Mixed with oximurate of potash, or nitrate of potash, and projected into a red hot crucible, a vivid combustion ensues, one of the products of which is the boracic acid. When it is treated with nitric acid, a great effervescence takes place, even in the cold; and when the fluid is evaporated, a great deal of the boracic acid is obtained. But of all the phenomena produced by the boracic radical in its contact with different substances, the most curious and the most important are those it exhibits with oxygen.

On projecting 3 decig. [4½ grs.] of boracic radical into a silver crucible scarcely at a dull red heat; and covering the crucible with a jar holding about a litre [a wine quart], filled with oxygen gas, and placed over mercury; a combustion of the most instantaneous kind takes place, and the mercury rises with such rapidity half way up the jar, as to raise it forcibly. In this experiment however, the combustion of the boracic radical is far from complete. What prevents this is, that the radical is at once converted entirely into the state of a black oxide, the existence of which we think we have perceived; and the external parts of this oxide passing afterwards to the state of boracic acid, they melt, and thus defend the interior parts from the contact of the oxygen. Accordingly to burn them completely it is necessary, to wash them, and place them afresh in contact with oxygen gas, still at a cherry red heat,

but then they burn with less violence, and absorb less oxygen, than the first time, because they are already oxided: and still the external parts, passing to the state of boracic acid, which melts, prevent the combustion of the interior parts; so that to convert them all into boracic acid, they must be subjected to a great number of successive combinations, and as many washings.

In all these combustions a fixation of oxygen constantly takes place, without any gas being disengaged; and they all afford products so acid, that, in treating these products with boiling water, boracic acid is obtained after suitable evaporation and refrigeration, a specimen of which we present to the Institute.

Lastly, the boracic radical comports itself in air precisely as in oxygen, with this difference only, that the combustion is less vivid.

From these experiments it follows, that the boracic acid is composed of oxygen and a combustible substance. Every thing convinces us, that this substance, for which we propose the name of *bore*, is of a peculiar nature, and ought to be ranked with phosphorus, carbon, and sulphur: and we presume, that, to acquire the state of boracic acid, it demands a large quantity of oxygen; but, before attaining this state, it becomes a black oxide.

NOTE, BY THE AUTHORS.

Several chemists have made experiments on the decomposition of boracic acid, whence they have deduced different consequences.

Fabroni asserted, that this acid was only a modification of the muriatic. *See* Fourcroy's Chemistry, art. Boracic Acid.

In the Annales de Chimie, vol. XXXV, p. 262, we find a long series of experiments on the phenomena exhibited by boracic acid on treating it with oximuriatic acid. These experiments are by Crell, who inferred from them, that carbon was one of the elements of this acid.

Lastly, Mr Davy, subjecting moistened boracic acid to the Voltaic pile, observed traces of a black combustible matter at the negative pole; but he says, that being occupied in researches upon the alkalis, he was unable to follow up the observation. *See* Mr Davy's paper, which arrived in France,

two months ago, and an abstract of which was inserted in the *Bulletin de la Société Philomatique* for the month of November.

Thus hitherto the principles of the boracic acid were not known. It is true, *we* * had announced to the Institute, that this acid contained oxygen, and consequently a combustible substance; but, as we had not recomposed it, we did not consider its nature as determined.

ON THE INFLUENCE OF GALVANIC ELECTRICITY ON THE TRANSITION OF MINERALS.

BY MR GUYTON †.

On examining five years ago a native oxide of antimony found in the province of Gallicia, which had been sent me by Mr Angulo, inspector general of the mines of Andalusia, I was led to consider this mineral as a transition from the state of a sulphuret to that of almost a pure oxide, which could have been effected only by the decomposition of water, determined by a subterranean electricity precisely similar to that we obtain in Volta's apparatus.

The external appearance of this mineral, which still evidently exhibits the structure of native crystallized sulphuret of antimony, and even in some parts the remains of a metallic lustre, leaves no doubt, that its entire mass was originally a sulphuret of antimony, the particles of which had undergone the slow and successive action of some agent, that had altered their composition, without disturbing their respective arrangement, precisely as we see in petrified wood, that retains its organization.

The proofs on which I grounded this explanation, and the applications I have made of this principle to the formation of other fossils, as the pyrites termed hepatic, gray copper ore, &c. have been detailed in a paper inserted in the Journal of the Polytechnic School, for July, 1802, p. 308.

* It is scarcely necessary here to tell us what *we* did, at a former period, for that is only to make *us* more conspicuous by being mentioned last Such language is disengenuous. Mr Davy evidently indicated the fact, and Messieurs Gay and Thenard only *followed up* the observation.

† Read at the Meeting of the Mathematical and Physical Class of the Institute, the 13th of July, 1807. Annales de Chimie, vol. LXIII, p. 113.

Mr Davy's views on the same subject, given at the end of his excellent Bakerian lecture read to the Royal Society on the 20th of November, 1806, where he speaks of the slow and silent operations of natural electricity even on the mineral system, inspired me with the idea of endeavouring to corroborate the inferences drawn from my former results, by performing the experiments with the more powerful apparatus, which we at present possess.

Messrs. Hatchette and Clement were soo good as to assist me in this undertaking. We formed a battery of 64 plates of copper and zinc, 15 cent. [near 6 inches] long by 10 cent. [near 4 inches] broad, affording a surface of 9600 cent. or about 1260 French inches square.

This battery was arranged in Mr van Marum's manner, that is, distributed in four piles, the first two of which were placed in a plate of copper with its edges turned up, and supported by an insulator. The pasteboards placed between pairs of metal were wetted with a strong solution of soda.

A piece of sulphuret of antimony was placed in a small glass two thirds full of distilled water, and a communication was established between the water and the two poles of the battery by means of two slips of platina.

As soon as the bubbles began to announce the decomposition of the water, a slight smell of sulphuretted hydrogen was perceptible. In two hours this smell was very strong, the water had assumed a yellow tint, and the surface of the sulphuret of antimony appeared of a deeper yellow, and as it were iridescent.

The slips of platina from the two poles were first fixed at some distance from the sulphuret; afterward they were brought near enough to touch it, and the acceleration of the disengagement of bubbles showed, that the activity of the battery had not slackened.

After the expiration of four hours, the smell of sulphuretted hydrogen was perceptible at a distance. A slip of silver, well cleaned, being placed on the edge of the glass without touching the water, was in a few minutes covered with a deep black coating. A drop of the water in the glass immediately formed a white precipitate in a solution of acetate of lead.

That part of the slip of platina, which was connected with the negative pole and immersed in the water, was black: and that which communicated with the positive pole had a slight yellow incrustation.

The battery having lost almost the whole of its activity at the expiration of eight hours, we attempted to take the piece of sulphuret out of the water; but the motion separating part of the yellow powder that covered it, to collect this we were obliged to throw the whole upon a filter.

This powder, dried in the air, exhibited the same reddish yellow tint as the native oxide of the province of Gallicia; and the fragment still retained evident traces of it on several points of its surface, when scarcely any remains of metallic lustre were distinguishable.

Hence we may presume to give this product of our imitation of the processes of nature as differing from the models she presents us only becouse the portion decomposed had not reached the same depth, and acquired the same consistency; in other words, because the result of an operation of a few hours cannot be perfectly similar to that of another, the duration of which depends on a uniform succession of agents, and the slowness of which prevents all possibility of its being disturbed.

If now we consider, that no one of the substances, which we may reasonably presume to exist in the bowels of the earth, acts in a similar manner, or produces the same changes in sulphuret of antimony when once formed, as I have shown in the paper printed in the Journal of the Polytechnic school, there appears to me no doubt, that the transition of the sulphuret of antimony of the province of Gallicia to the state of native oxide (in which it loses more than 0·17 of sulphur, and acquires 0·18 of oxigen) results directly from the decomposition of water by galvanic electricity. If it be strictly possible for the same effect to be produced by a different cause, it is certain, that the instances are much more rare, than is commonly supposed; and that the greater number appears to belong to this class, only because we confound the remote with the immediate cause, the process with the chemical action, the form of the agent with the nature, and, if I may be allowed the expression, the handle with the tool. But when the effect is characterised, as in this particular case, by circumstances that imprint on it the seal of a distinct cause, and excludes any other known cause, we have not a probability only, the certainty of the cause is equal to the certainty of the effect.

We have since sought for new proofs of this conclusion, extending our experiments to other minerals, where the signs of a transition of this kind were most manifest.

Sulphuret of iron, poor in metal, hard, compact, and of great lustre, merited attention in this point of view more parti-

cularly, because the Pyrites of Berezoff, which is found in the same state of alteration, in its primitive state resists the action of the most powerful solvents, yielding only to the nitric acid and the nitro-muriatic.

On a pyrites of this kind, and the gray silver ore (crystallized *fahlerz*), we endeavoured to produce analogous alterations.

Being exposed in distilled water to the action of the same battery, and communications established in a similar manner, the smell of sulphuretted hidrogen was perceived, and the water rendered turbid; the slips of platina were coloured, as in the former experiment, black on the negative sides, and brownish yellow on the positive; the water, which was strongly acid, precipitated acetate of lead; and the fragments of the sulphurets were left in a state of division, almost pulverulent, and covered with pellicles of a dull colour and without lustre.

The sulphuret of iron in particular exhibited a very striking alteration on its surface. Having attached the conductors before water was put into the glass, the sulphuret was vividly inflamed; which astonished us the more because in a preceding experiment a fragment of transparent native sulphur did not exhibit the least sign of inflammation, when touched with the platina exciter under a jar filled with oxigen gas, though the battery was powerful enough to burn the iron wire.

It even appeared to us, in the last experiment, that the inflammation of the sulphuret took place instantaneously after it had been covered with water; but the effect was so rapid, that we dare not assert this as a certainty.

We purpose to pursue these experiments, and in the mean time I think I may conclude, that those of which I have just given an account, while they confirm my explanation of the transition of brilliant crystallized sulphuret of antimony to the state of an earthy yellow oxide, without losing its configuration, afford a new mean for interrogating nature respecting the composition of bodies, the proportions of their component parts, and the succession of changes effected in their combinations. The desulphuration of ores is one of the most important points in metallurgy; and if, in the present state of our knowledge, we can scarcely discern any possibility of availing ourselves of this mean in processes in the large way; those of assaying cannot fail to derive more certain results from its application.

ON ARTIFICIAL SANDSTONES, THAT HAVE UNDERGONE A REGULAR CONTRACTION IN THE FIRE.

BY MR. ALLUAU *.

On examining with Mr. Leopold Chevaillers the scoriæ produced in the operation of parting bell metal, which was performed under his direction at Limoges, I found masses of artificial sandstone, which by a regular contraction had divided itself into prisms, precisely resembling the basaltic columns, that exist in all volcanic countries.

These sandstones, which served as a cupel to the melting furnace, are composed of a fine grained sand, the remains of granites; the other component parts of which had been decomposed. To separate them, and obtain the purest siliceous grains, they were carefully washed and decanted, they were afterward mixed with water loaded with clay, to impart to them the body requisite for their use; and a little charcoal powder was added, which, diminishing the points of contact between the siliceous particles and the metallic oxides, rendered them less vitrescible, and thus prolonged the duration of the cupel of the furnace.

To form it, a stratum of this mixture 15 to 20 cent. [6 or 8 inches] thick was placed on the floor of the furnace, and strongly beaten down as it was gradually dried by a gentle heat. After being used a certain time, it was necessary to renew the whole stratum, and all the sandstones arising from it had experienced the same contraction.

The upper part of these prismatic sandstones is covered with a scorified metallic stratum 4 or 5 cent. [about $1\frac{1}{2}$ or 2 inches] thick, that serves to hold together all the prisms, which are notwithstanding easily separable. The degree of heat has been more intense near this stratum, than in the inferior part: accordingly the sandstone there is harder and more compact, being difficult to penetrate; while the other extremity of the prisim s easily crumbled by the fingers. The fire however has been sufficiently violent throughout the whole thickness of the mass, to vitrify the metallic fragments disseminated through the sand.

* Abridged from the Journal de Physique, vol. LXV, p. 228.

These prisms extend to the length of 15 cent. [5·9 inch.] and from 1 to 2 or even 3 [0·39, to 0·78, or 1·18 of an inch] in diameter. They are parallel to each other, and have their axis constantly perpendicular to the metallic stratum that covers them. Though the number of their sides is not constant, they are most frequently six. Their edges are sharp, and pretty straight. Their faces are not strictly planes, but a little concave; and, what is remarkable, they appear to have been more powerfully heated than the interior of the prism, a circumstance I conceive to be ascribed to the last molecules of caloric, which have escaped as through so many channels by the clefts or intervals, that were formed between the adjacent faces of the prisms.

When these sandstones have not been so strongly heated, the aggregation and prismatic division is not so well characterised. Then too the charcoal, deprived of the air necessary for its combustion, has arranged itself in longitudinal zones parallel with the axis of the prism, and so as to leave between them intervals of 2 or 3 millim. [0·787 or 1·18 of a line]. This singular phenomenon appears to me occasioned by the caloric, which, absorbed by the metallic stratum, taking the shortest course to reach it, and finding itself stopped in its progress by the particles of charcoal equally disseminated through the mass of sand, pushed them aside to the right and left by imperceptible degrees to open itself a passage, and has thus dispersed them in little parallel strata or threads, as if they had yielded to the laws of affinity, which always tend to bring together homogeneal particles, when suspended by a fluid in a suitable state of rest.

If we invert one of these masses of sandstone, it is a very good representation of the bottom of a basaltic stratum. In short it is impossible to have a more perfect model of its mechanical division *.

Naturalists have already remarked clays, that have undergone a regular contraction in the fire: but, beside that silex forms more than nine tenths of the mass of this sandstone of Mr. Chevaillers, this effect had not been observed in such a constant manner on such large blocks, as Dolomieu said in speaking of the configuration of basaltes. An effect so frequently repeated must have its causes.

REFLECTIONS ON THE CONFIGURATION OF BASALTES.

At a time when men were ignorant of the first principles of crystallography, and but few crystals were known, it was

* The piece I preserve in e y collection is about 4 dec. [15 ⅔ inches long,] adn em2 dec. [7 inches and threquartr. orbs]ad.

difficult certainly, to avoid confounding with them solids that exhibited some external appearance of their regularity. Thus Cronstedt, Wallerius, and other celebrated naturalists thought basaltic prisms were the direct products of crystallization.

Romè de Lisle at first adopted the mistake of his predecessors: but he had scarcely raised the veil, that enveloped the mechanism of crystallization, when he sought for another cause of the prismatic division of basaltes, and then the happy idea of a contraction offered itself to his mind.

But since the genius of Hauy has developed the theory of crystallization in such a learned manner, may we not be astonished still to find naturalists, who are desirous of assimilating basaltic columns with the productions of regular aggregation?

Setting aside therefore every idea of the crystallization of basaltes, I shall confine myself to the refutation of a slight objection of its partizans to the numerous proofs of its contraction, and I shall attempt to follow its mechanism, in examining the laws to which bodies are subjected in cooling.

They admit, that the cooling of the bassaltes must have occasioned divisions, that would naturally give rise to some forms; but they add, that these forms, resulting from chance, and a thousand different accidents, could only be very irregular, and not produce vast columns, as remarkable for their regularity as for the uniform arrangement that characterises their extensive masses.

But why should these forms depend on accidents guided by the hand of chance? I can conceive no reason for this; since, if the cause of the contraction be constant, and if the manner in which it operates be always the same, ought not their results to bear the stamp of this uniformity of circumstances? Do not the cracks of clay dried by a scorching sun sometimes exhibit polygons nearly regular? Do not the cracks in the glaze of pottery, which superficially examined appear destitute of symmetry, resemble on closer inspection a kind of mossaic issuing from the hand of a single artist?

Mr Patrin even mentions a piece of ancient enamel in the collection of Mr Dolomieu, the surface of which exhibits throughout hexagonal figures, representing in minature a horizontal section of a basaltic causeway. But who can conceive with him, that these hexagons are the effect of crystallization? Is it not evident, that the metallic base, on which the enamel rests, being capable of greater dilatation, may under various circumstances have occasioned cracks, the unusual regularity of which gives at first sight an erroneous idea of their causes?

The basaltic prisms then are the result of a regular contraction, and the hypothesis of Dolomieu, which ascribes it to a refrigeration accelerated by the contact of a body that quickly imbibes caloric, agrees perfectly with the division of the sandstone of Mr Chevaillers, the surface of which is covered with a scorified metallic stratum serving as a conductor to the caloric.

If geologists be not agreed on the formation of basaltes, they cannot refuse to admit, that caloric performs one of the principal parts in it; whether it act alone, or in concert with other solvent gasses, known or unknown to naturalists: and the latter, as they are extricated, may furnish analogous results.

When a body is strongly heated, if the action of caloric come to cease suddenly, the body experiences the most intense degree of heat at the instant when the caloric escapes. In fact, the caloric, rushing rapidly toward the body that absorbs it in proportion to the strength of its affinity, accumulates on the parts which it traverses as a powder does on a sieve, and sets in motion the particles of the body, which almost at the same instant are briskly separated and left to the attraction of cohesion that tends to unite them. Spheres of attraction are then established between the particles of caloric that are flying off, and those of the substance itself, which tend to unite.

If this substance be a good conductor of heat, and the attractive power of its particles equal the expansive power of the caloric, it will return to its natural state without change of form. Such is a metal in fusion, which is left to cool gradually.

If, under the same circumstances, the caloric, rapidly absorbed, is separated in successive strata, this substance will separate into planes, which will be perpendicular to the direction the the caloric takes to escape. Such is the case with cast iron in fusion, the surface of which is wetted to separate thin cakes from it: a cause analogous to what may have divided basaltes into leaves, or thin strata, either perpendicular to the axis of the prisms, or around a globular mass.

If, the motion of the caloric being uniform, the attraction of cohesion do not equal the expansile power, the particles of the substance will remain dilated; and then, if it be a good conductor of heat, they will maintain their situation without experiencing any division. Such is the effect of tempering steel, where the cohesive power of the particles of iron is broken by the interposition of carbon. But if the substance be not a good conductor of heat, it will fall to powder; as quartz

strongly heated and immersed in water. The first of these circumstances has perhaps never occurred in volcanic productions, but the other must have been very frequent.

To obtain prismatic divisions, let us suppose a basaltic mass still in its pasty state covering a considerable plain; and which, yielding to the laws of gravity, adheres strongly to the base that supports it. Then, if the expansive force of the igneous or aqueous gasses happen to cease in consequence of their sudden or accelerated extrication, the particles, losing their fluid state, will tend to approach each other, yielding to the laws of gravitation, and also obeying the attraction of cohesion that they exert toward each other; and they cannot contract, but by following the diagonal direction resulting from these two powers. But the extent of this mass, its gravity, and the inequality of surfaces, opposing a general contraction like that which is experienced by a cake of clay exposed to the fire on a support, there will necessarily be a vibration, and cracks that will determine spheres of attraction, round which the particles will agglomerate; and the centres will be so much more numerous, and the radii less, as the attractive force is more considerable.

NOTE BY THE EDITOR.

Part of this explanation is highly ingenious; but there is no need for introducing a mysterious attractive power, in order to explain the effects. A little reflexion will show, that a mass, of which the particles have little cohesion, and which is, at the same time, of considerable magnitude, must, in giving out either heat and water, contract into smaller portions; that, if it be of regular composition throughout, these portions will be of regular form; and that they will also be large or small according to the cohesion of the particles, or, in other words, the agreement of their superficial forms influenced by aerial pressure; the whole being also modified by the extent and depth of the mass.

OBSERVATIONS ON THE OXIGENIZED MURIATIC ACID.

BY MR. JOSEPH MOJON, PROFESSOR OF PHARMACEUTIC CHEMISTRY IN THE MEDICAL SCHOOL OF GENOA, &c. *

In making oxigenized muriatic acid, I have several times had occasion to observe, after having emptied the receiver, into

* Annales de Chimie, Vol. LXIV. p. 264.

which I had distilled the acid, and left it a few hours exposed to the light, that the little portion of acid, which commonly adheres to the inside of the receiver, lost entirely its peculiar suffocating smell, and acquired an aromatic odour perfectly analogous to that of muriatic ether. I remarked besides, that the oxigenized muriatic acid, though retained in bottles well stopped, and luted so that the gas cannot exhale, yet, if it remain some time exposed to the action of the sun, not only ceases to fume, but also acquires an ethereal smell, similar to that of muriatic alcohol or ether.

This transmutation of oxigenized into simple muriatic acid, without the excess of oxigen being able to escape, as also the ethereal smell it acquires by simple exposure to light, led me more than once to suspect, that the oxigen in this case, instead of being extricated in the form of gas, entered into fresh combinations, and formed ether.

To convince myself whether ether were really formed, I took a bottle filled with oxigenized muriatic acid, which had been left exposed to light almost two years, and had acquired the ethereal smell, I have mentioned. I saturated it with magnesia; and distilled the whole in a glass retort with a very gentle heat, till I had obtained a few ounces of a fluid, which I rectified afresh in a small retort over a lamp. This afforded me a perfectly limpid, colourless liquor, of a very penetrating ethereal smell, and a taste resembling that of muriatic ether diluted with water. It did not change the colour of infusion of mallow flowers; and it did not take fire at the flame of a candle, being still very dilute.

The small quantity of liquor obtained by this process not allowing me to proceed to a fresh rectification, in order to deprive it entirely of the superabundant water it contained, I mean to make new trials with a larger quantity of acid.

From the observations I have thus briefly given, and which no doubt deserve to be repeated and confirmed by farther experiments, I am far from pretending to explain by vague hypothesis the formation of alcohol, or of ether, by oximuriatic acid, and to point out whence it derives its component parts. We may suppose, however, that a portion of ether is formed at the time of distilling the oximuriatic acid, and that the potent and suffocating smell of this acid prevents that of the ether from being perceived. In fact, the celebrated Giobert of Turin, in distilling oximuriatic acid sixteen years ago, observed a volatile oil similar to that which Mr. Westrumb had discovered some time before him. Mr. Giobert tells us, that this oil is of a yellowish brown colour, very clear, and analogous to the *oleum*

vini; but that it is difficult to determine its precise quantity, since when once separated, it dissolves anew very readily in the aqueous vapours, that fall into the receiver. This chemist imagined he might estimate the quantity of oil obtained from a mixture of a pound of sulphuric acid with eighteen ounces of muriate of soda at 30 or 35 grains.

OF THE ACTION OF NITRIC ADID ON CORK.

BY MR. CHEVREUL *.

Brugnatelli having examined the action of nitric acid on cork, in 1787, found, that the cork was converted into a peculiar acid. In 1797 Bouillon-Lagrange resumed the inquiry of the Italian chemist, and confirmed the existence of the suberic acid. In the two papers he published on this subject, he described the characters of this acid, and its combinations with the salifiable bases, which Brugnatelli had not studied. Notwithstanding these labours, several persons still entertained doubts of the existence of this acid. They thought, that it was only one of the acids previously known, combined with some matter, by which its properties were concealed. Of the truth of this I was desirous to satisfy myself by experiment.

To form suberic acid, I followed the common process; which I shall here recite, with the phenomena that occurred in the operation.

In a retort, to which a receiver was adapted, I heated six parts of nitric acid at 29° on one of rasped cork. The matter grew yellow; nitrous gas mixed with carbonic acid was evolved; and a pretty large quantity of prussic acid was formed. I returned the product from the receiver into the retort several times, that the cork might be acted upon sufficiently. When the action of the acid appeared to abate, I poured the matter still hot into a porcelain capsule, where I finished the evaporation with a gentle heat, stirring it continually. As soon as it was reduced to the consistence of an extract, I put it with some water into a large glass phial on a sand heat. At the end of a few hours, I withdrew it from the fire; and, on cooling, two solid

* Annales de Chimie, vol. LXII. p. 323.

substances separated. One of these, which I shall call A, sunk to the bottom in the form of large flakes: the other, B, congealed on the surface of the liquor like wax. This I removed with a piece of card; the other I separated by filtration.

The flocculent precipitate, A, was insipid; insoluble in water and in alcohol; and of a white colour, but turning a little brown on exposure to the air. Nitric acid at 32° did not act on it perceptibly. Placed on a red hot coal, it burned without swelling up, and emitted a pungent smell of empyreumatic vinegar. Its coal was bulky, and pretty hard. This substance therefore was nothing but the woody part naturally contained in the cork.

The supernatant substance, B, had very little taste. It was insoluble in water; but boiling alcohol dissolved it, some portion of woody matter excepted. The filtered solution, on cooling, let fall a white substance resembling wax. This being separated by a second filtration, I added water to the solution, which threw down a straw coloured resinous substance, that turned reddish by exposure to the air, and was acid, notwithstanding I had washed it repeatedly. On distillation, it yielded a sort of concrete fat, and a very acid fluid, that precipitated acetate of lead. I could not ascertain its nature from the smallness of its quantity.

The water that had been employed to precipitate the resin acquired a yellow colour by evaporation, and a taste resembling that of bitter almonds. It contained only a little of the yellow matter, and probably a few atoms of prussic acid.

The fluid from which the matter A had been separated had an acid and bitter taste; precipitated lime water and calcareous salts; turned solution of indigo green; contained a little iron, as appeared on the addition of galls; and, when the excess of acid was saturated, it did not precipitate gelatine, consequently contained none of the tannin of Mr. Hatchett.

In evaporating the fluid with a gentle heat, it emitted a pretty decided smell of vinegar. This induced me to finish the evaporation in a retort; but I obtained only nitric acid, without any acetous. Whether this were dissipated at the commencement, or its quantity were too small for me to detect it, I cannot say. The liquor, after evaporation and cooling, let fall an *acid sedimental matter*, which I separated by filtration. Four successive evaporations afforded me fresh acid. After the fifth evaporation I obtained crystals of oxalic acid. Having decanted the mother water, which was yellow, and had a very bitter taste, I precipitated the oxalic acid it still retained by lime water in excess, and distilled it. The liquid that came over

into the receiver contained a little ammonia. I then precipitated the liquid left in the retort by carbonate of potash, and lime was thrown down. The filtered liquor yielded in a couple of days some small gold coloured crystals of the bitter yellow matter combined with potash *.

This acid sedimental matter was the suberic acid. I washed off with cold water part of the yellow matter that coloured it, and completed its purification by repeated solution in boiling water, from which it separated by cooling in little white flakes. By concentrating the bitter waters, I separated that which they held in solution. By this process I obtained a very white acid, about five parts of which were obtained from sixty of cork.

The suberic acid is as white as starch. It has an acid taste, without any bitterness. Light does not alter its whiteness. To dissolve one part of this acid requires 38 parts of water at 60° [140° F.] and 80 parts at 13° [554° F.]. Its little solubility prevents us from having it crystallized; so that when it is dry it is always pulverulent and opake.

Thrown on hot coals, it is volatilized, without leaving any residuum, and emitting a smell of suet.

When heated in a small glass retort on sand, it melts like fat with a gentle heat. If the retort be withdrawn from the fire, and the melted acid diffused over its inside, it crystallizes in needles by cooling. If the distillation be continued, it rises in vapours, which condense in the summit of the retort in white needles, some of which are half an inch long. This sublimate has all the characters of suberic acid. A slight coally mark is left in the retort.

Suberic acid dissolved in water reddens litmus very distinctly. It does not precipitate lime †, strontian, or barytes water, or the saline combinations of these bases. On evaporating lime-water saturated with suberic acid, the calcareous suberate falls down in a white flocculent precipitate, from which muriatic acid separates the suberic. This is indeed an excellent method of obtaining it perfectly white. The muriate of lime

* Having saturated the mother water of these crystals with muriatic acid, I obtained a precipitate, which exhibited all the characteristics of benzoic acid: but I dare not venture to assert, that this acid is constantly formed, for in three operations on cork I obtained it but once, and then in a very small quantity.

† It seems to me, that Mr. Brugnatelli must have deceived himself, when he says, that suberic acid precipitates lime water, and all the mineral calcareous salts. The oxalic acid, which no person has mentioned, and which is formed with the suberic acid, was no doubt the occasion of the precipitate he obtained. It appears to me also, on reading the article suberic acid in Brugnatelli's Elements of Chemistry, vol. II, p. 106, that the acid he describes still retains bitter matter, resinous matter, and oxalic acid.

may be separated from it, by dissolving it in a small quantity of hot water; when, by cooling, we obtain the acid, which is always in a pulverulent form *, and similar to what it was before being combined with the lime; only this base takes from it the remains of the colouring matter, which the water had not dissolved.

Ammonia and the fixed alkalis dissolve suberic acid very well. These combinations, when concentrated, let fall their acid on the addition of sulphuric acid, muriatic, &c.

The suberate of ammonia precipitates the solution of alum, and the nitrate and muriate of lime. But to obtain precipitates with the latter, concentrated solutions must be employed, for the suberate of lime is pretty soluble.

Suberic acid throws down a white precipitate from a perfectly neutral solution of silver, from muriate of tin at a minimum, from sulphate of iron at a minimum, from nitrate and acetate of lead, and from nitrate of mercury. It does not precipitate sulphate of copper † or of zinc.

Suberate of ammonia decomposes almost all the metallic solutions. The cupreous salts are precipitated by it of a pale blue; the cobaltic, rose-coloured; those of zinc, white; &c.

Nitric acid has no action on the suberic. I boiled twelve parts of the former at 32° on one of the latter, without having any sensible decomposition. The suberic acid was dissolved, and this solution, being boiled down, deposited suberic acid some hours after cooling. I observed, that the addition of water promoted this separation. I thought at first, that I might obtain crystals from this acid solution, but I could not succeed.

Alcohol dissolves the suberic acid very well. When saturated with it, water precipitates a portion.

The suberic acid does not turn green the solution of indigo in sulphuric acid. Mr. Bouillon-Lagrange however lays much stress on this property, which he considers as a characteristic of the acid; and in fact if this change of colour were owing to a chemical action, it would be very surprising, that a substance

* I made this experiment, in order to see whether the suberic acid were analogous to the benzoic, and, in this case, to separate it from the matter that prevented its crystallization.

I repeated the same experiment with barytes instead of lime, and had the same result. The suberate of barytes is deposited by concentration, and its decomposition by muriatic acid afforded me the suberic acid perfectly white. A small excess of the acid should always be employed, in order to separate the last portions of base, which the suberic acid might retain.

† Bouillon Lagrange says, Ann. de Chimie, vol. XXIII, p. 48, that the suberic acid decomposes nitrate of mercury, and the sulphates of copper, iron, and zinc; and p. 56, that the suberic acid yields mercury and zinc to the three mineral acids, and iron and copper to sulphuric acid; which appears to me contradictory.

formed amidst nitric acid should not have attained its complete oxidation, but remain capable of deoxiding indigo. M. Bouillon-Lagrange has ascribed to the suberic acid a property, that belongs to the bitter yellow matter, which forms a green by mixture with the blue of the indigo. It is this too, that turns a solution of copper green; for I have satisfied myself, that the white acid merely dilutes the blue colour, just as an equal quantity of water would have done.

From what has been said I conclude, that the suberic acid has great analogy with the sebacic, with which M. Thenard has made us acquainted *; and that the only striking difference between them is the crystalline form, which the suberic acid assumes when dissolved in water or in alcohol.

ON THE CHEMICAL NATURE OF THE SMUT IN WHEAT.

BY MESSRS. FOURCROY AND VAUQUELIN †.

The smut in wheat has already occupied the attention of several chemists. Parmentier has found in it a fetid, fat, and coally substance. Cornet has observed its oleaginous nature. Girod-Chantraus, in 1804, announced, that it contained also a free, fixed acid, which he supposed to be of a peculiar nature.

This discovery, announced to the Institute in the autumn of that year, induced Mr. Vauquelin and me to undertake a full examination of this degenerated vegetable matter.

It is well known, that the smut is in fact a corruption of the grain, which exhibits within the husk of the seed, instead of a farinaceous substance, a black, greasy, stinking powder, the most decided and dangerous characteristic of which is its being capable of infecting other grains by contact, and imparting to them the property of propagating smutty wheat. It is known too, that washing with lime and alkalis is the most certain method of removing its contagious property, and preventing the disease from being reproduced, which it constantly is,

* La Revue Philosophique, &c. Nov. 1805. Abridged from a paper read at the National Institute.

if this practice, now generally employed by all judicious farmers, be neglected.

The smut, an which we made our experiments, was given us by M. Girod-Chantrans.

Triturated in an agate mortar, and separated from the husk, the smut imparted to hot alcohol a yellowish green colour; and, without communicating to it any character of acidity, exhibited only about a hundredth part of its weight of a deep green oily matter, as thick as butter, and acrid as rancid grease.

Ether separated from it the same oil.

After this action of alcohol, the smut retained both its greasy feel, and filthy smell. Lixiviated with five times its weight of boiling water, it gave it a red brown colour, a fetid smell, a soapy quality, and a very decided acidity.

This acid, examined by various appropriate reagents, exhibited all the properties of the phosphoric.

On lixiviating pure smut, not previously treated by alcohol, with boiling distilled water, this liquor, which was perceptibly acid, being saturated with potash, gave a precipitate of animal matter, mixed with crystallized ammoniaco-magnesian phosphate, and every proof of an alkaline phosphate. These experiments therefore confirm the existence of free phosphoric acid in smut, known by its fixedness, its insolubility in alcohol, its solubility in water, its precipitation by lime, &c.

After the aqueous infusion had been precipitated by potash, it held in solution a fetid animal matter, resembling in colour, smell, and the phenomena exhibited by its precipitation with various reagents, that found in water in which the gluten of wheat has putrefied.

After having undergone the action of alcohol and water successively, the smut of wheat still retained both its fetid smell and greasy feel. Distilled on an open fire it afforded a third of its weight of water impregnated with acid acetate of ammonia; nearly a third of a deep brown, concrete oil, much resembling adipocere in its form, consistence, and fusibility by a gentle heat; and 0·23 of a coal, which, being incinerated, left 1 gramme [15½ grs.], being a hundredth part of the original smut, of white ashes, three fourths of which were phosphate of magnesia, and one fourth phosphate of lime.

We examined the smut with its husk, to compare it with that which had been deprived of it, but we did not find difference enough to ascribe to the bran that covers it any decided influence on its analysis.

From our examination, the leading results of which have just been given, we conclude, that the smut of wheat contains,

1. A green, butyraceous, fetid, and acrid oil, soluble in hot alcohol or ether, composing near a third of its weight, and imparting to it its greasy consistence.

2. A vegeto-animal substance, soluble in water, insoluble in alcohol, and precipitating most of the metallic salts, as well as galls. It composes rather less than a fourth of the smut, and is perfectly similar to what comes from putrified gluten.

3. A coal, amounting to one fifth of its quantity, which gives a black colour to the whole mass; and is an evidence, as it is the product, of a putrid decomposition; a part which it acts equally in mould, and in all the remnants of putrified organic compounds.

4. Free phosphoric acid, scarcely constituting more than ·004 of the smut, but sufficient to impart to it the property of reddening blue vegetable colours.

Lastly, the phosphates of ammonia, magnesia, and lime, in the proportion of a few thousandths only.

The smut of wheat then is nothing more then a residuum of the putrified grain, which, instead of its original component parts, starch, gluten, and saccharine matter, exhibits only a kind of carbonaceous oily substance, very analogous to a kind of bitumen of animal or vegeto-animal origin.

We must here remark, that in our examination of gluten decomposed by putrefaction, we found characters very similar to those of the smut of wheat; and that the products of the one are so like those of the other, as to render it difficult in certain cases not to confound them together. It requires a man to be well practised in chemical experiments, to discern the slight differences, that exist between these two putrified matters, because these differences consist only in delicate shades, that are not easily perceivable.

Interesting as the results of this analysis may appear, we must confess, there is still a great distance from the knowledge they give us of its nature to that of its cause; and yet more to that of its contagious quality, which is proved by so many experiments, as to leave no room for the slightest doubt. We must own too, that these results, while they indicate the smut to be the residuum of putrified farina, do not entirely agree with the ideas of philosophical agriculturists, who consider this disease as the necessary product of contagion; since it thus seems natural to presume it arises from putrid decomposition, which may proceed from any other circumstance as well as a communicated germe.

The same results lead us equally to infer, that the putrescency, which necessarily precedes the formation of the smut in all cases, whether it depend on contagion or arise spontaneously, attacks particularly the gluten; and precedes, indeed prevents, the formation of the starch: since we know positively, that this fecula, no traces of which are found in the smut of wheat, suffers no alteration from that septic process, which so powerfully attacks the glutinous substance.

NOTE ON THE ALTERATION WHICH AIR AND WATER PRODUCE IN FLESH.

BY MR. C. L. BERTHOLLET *.

I boiled some beef, renewing the water from time to time, till the water no longer afforded a precipitate with tannin. I then suspended it in a glass cylinder filled with atmospheric air, which rested on a plate filled with water. After a few days the oxigen was found to be converted into carbonic acid; the interior of the cylinder was filled with a putrid smell; the beef, subjected to ebullition, again afforded a pretty copious precipitate with tannin: the boiling was repeated, till tannin ceased to render the water turbid; and the beef, having almost entirely lost its smell, was replaced in the same apparatus.

The operation was repeated several times, and the following were the results.

The alteration of the atmospheric air, and the emission of the putrid smell, gradually slackened; the quantity of gelatine formed progressively diminished; the water on which the vessel rested gave but slight indications of ammonia throughout the whole process: when I terminated it, no putrid smell was perceptible, but a smell resembling that of cheese: and in fact the animal substance, which scarcely retained any fibrous appearance, had not only the smell, but precisely the taste of old cheese.

I distilled separately equal weights of beef and Gruyere cheese, employing two glass bodies, each of which communicated with a tube opening under water. The operation was

* Journal de Physique, vol. LXV, p. 466.

conducted so as to decompose the two substances as far as possible, and retain all the ammonia, that was evolved. On comparing the quantities of ammonia, that afforded by the cheese was to that of the beef nearly as 19 to 24: whence it appears, that a distinguishing characteristic of the caseous substance is to contain less nitrogen than flesh.

If any inference may be drawn from experiments so incomplete as the preceding, it would appear,

1. That the gelatine obtainable from an animal substance does not exist completely formed in it; but that, when this substance has been exhausted by the action of water, more may be formed by the action of the air, the oxygen of which combines with the carbon, while a portion of the substance, that was before solid, becomes gelatinous, as a solid part of a vegetable becomes solid by the action of the air.

It must be remarked, however, that the property of precipitating with tannin belongs to substances which have very different qualities in other respects. I have found, that the decoction of Gruyere cheese formed a copious precipitate with tannin.

2. That nitrogen enters into the composition of the putrid gas, forming no doubt with hydrogen a combination less stable than ammonia, or perhaps taking an intermediate state; but, when its proportion is diminished to a certain degree, it is more strongly retained by the substance, and ceases to produce putrid gas. This substance, which is characterized by the putrid smell, appears to be rather a very evaporable compound, that unites with all gasses, like other elastic vapours, than a permanent gas.

3. Since the caseous part has less nitrogen than most other animal substances, we may conjecture, that this part becomes more and more animalized during life, acquiring a greater proportion of nitrogen and hydrogen; which may be explained by the more intimate combination of the oxygen and hydrogen, that enter into its composition, and by the separation of carbon in the act of respiration; so that the last term of chemical action during life is the production of uree, agreeably to the opinion of Mr Fourcroy *.

* Systême des Connoissances Chimiques, Tom. 10, p. 165.

CHEMICAL MISCELLANIES.

BY MR LINK, PROFESSOR OF CHEMISTRY AT ROSTOCK ‡.

I have just examined the pollen of the hazel nut. It differs greatly from that of the date tree, which Messrs. Fourcroy and Vauquelin have analysed. It contains a large quantity of tannin, a resin, a great deal of gluten, and a little fibrin. There is animal matter therefore in this pollen.

To learn the properties of the membranous part of plants, I subjected to research the pith of elder, and procured from it by nitric acid every thing which Bouillon-Lagrange obtained from cork, but without this substance leaving any residum.

As Mr Brugnatelli obtained suberic acid from paper, I believe it is a peculiar characteristic of vegetable membrane, to furnish this acid.

In the roots of the *Oenothera biennis*, broadleaved tree-primrose, I have seen by the help of a good microscope extremely small crystals, regularly formed, accumulated in the cellular texture. It was difficult to obtain a sufficient quantity for a chemical analyses. They appeared to me somewhat analogous to the crystals obtained from indigo by Nicholson; they are very little, if at all, soluble in water, alcohol, or many of the acids: sulphuric acid itself acts but very feebly on them; the nitric acid alone is their true solvent.

I have endeavoured to blacken the muriate of silver by a current of air employed in the dark, but found it impossible to succeed.

Mr Berthollet, as I see in his work, was able to blacken it by a simple current of air. He says, that light acts upon this salt by taking from it a portion of muriatic acid. But how will this celebrated chemist account for the black colour, that muriate of silver assumes when covered with muriatic acid?

‡ Annales de Chimie, Vol. LXII. p. 292.

VEGETABLE PHYSIOLOGY.

ON THE ORIGIN AND FORMATION OF ROOTS.

IN A LETTER FROM T. A. KNIGHT, ESQ. F. R. S. TO THE RIGHT HON. SIR JOSEPH BANKS, K. B. P. R. S. *

In a former communication, I have given an account of some experiments, which induced me to conclude that the buds of trees invariably spring from their alburnum, to which they are always connected by central vessels of greater or less length; and, in the course of much subsequent experience, I have not found any reason to change the opinion that I have there given. † The object of the present communication is to show, that the roots of trees are always generated by the vessels which pass from the cotyledons of the seed, and from the leaves, through the leaf-stalks and the back, and that they never, under any circumstances, spring immediately from the alburnum.

The organ, which naturalists have called the radicle in the seed, is generally supposed to be analogous to the root of the plant, and to become a perfect root during germination; and I do not know that this opinion has ever been controverted, though I believe that, when closely investigated, it will prove to be founded in error.

A root, in all cases with which I am acquainted, elongates only by new parts which are successively added to its apex or point, and never, like the stem or branch, by the extension of parts previously organized; and I have endeavoured to show, in a former memoir, that owing to this difference in the mode of the growth of the root and lengthened plumule of germinating seeds, the one must ever be obedient to gravitation, and point towards the centre of the earth, whilst the other must take the opposite direction. ‡ But the radicle

* From Philosophical Transactions for 1809, Part I.
† Phil. Trans. 1805. ‡ Ibid. 1806.

of germinating seeds elongates by the extension of parts previously organized, and in a great number of cases, which must be familiar to every person's observation, raises the cotyledons out of the mould in which the seed is placed to vegetate. The mode of growth of the radicle is therefore similar to that of the substance which occupies the spaces between the buds near the point of the succulent annual shoot, and totally different from that of the proper root of the plant, which I conceive to come first into existence during the germination of the seed; and to spring from the point of what is called the radicle. At this period, neither the radicle nor cotyledons contain any alburnum; and therefore the first root cannot originate from that substance; but the cortical vessels are then filled with sap, and apparently in full action, and through these the sap appears to descend which gives existence to the true root.

When first emitted, the root consists only of cellular substance, similar to that of the bark of other parts of the future true, and within this the cortical vessels are subsequently generated in a circle, inclosing within it a small portion of the cellular substance, which forms the pith or medulla of the root. The cortical vessels soon enter on their office of generating alburnous matter; and a transverse section of the root then shows the alburnum arranged in the form of wedges round the medulla, as it is subsequently deposited on the central vessels of the succulent annual shoot, and on the surface of the alburnum of the stems and branches of older trees. *

If a leaf-stalk be deeply wounded, a cellular substance, similar to that of the bark and young root, is protruded from the upper lip of the wound, but never from the lower; and the leaf-stalks of many plants possess the power of emitting roots, which power cannot have resided in alburnum, for the leaf-stalk does not contain any; but vessels, similar to those of the bark and radicle, abounding in it, apparently convey the returning sap; and from these vessels, or perhaps more properly from the fluid they convey, the roots emitted by the leaf-stalk derive their existence. †

If a portion of the bark of a vine, or other tree, which readily emits roots, be taken off in a circle extending round its stem, so as to intercept entirely the passage of any fluid through the bark; and any body which contains much moisture be applied, numerous roots will soon be emitted into it

* Philosophical Transactions for 1801, Plate xxvii. † Ibid for 1801.

immediately above the decorticated space, but never immediately beneath it: and when the alburnum in the decorticated spaces has become lifeless to a considerable depth, buds are usually protruded beneath, but never immediately above it, apparently owing to the obstruction of the ascending sap. The roots, which are emitted in the preceding case, do not appear in any degree to differ from those which descend from the radicles of generating seeds, and both apparently derive their matter from the fluid which descends through the cortical vessels.

There are several varieties of the apple tree, the trunks and branches of which are almost covered with rough excrescenses, formed by congeries of points which would have become roots under favourable circumstances; and such varieties are always very readily propagated by cuttings. Having thus obtained a considerable number of plants of one of these varieties, the excrescences began to form upon their stems when two years old, and mould being then applied to them in the spring, numerous roots were emitted into it early in the summer. The mould was at the same time raised round, and applied to the stems of other trees of the same age and variety, and in every respect similar, except that the tops of the latter were cut off a short distance above the lowest excrescence, so that there were no buds or leaves from which sap could descend to generate or feed new roots; and under these circumstances no roots, but numerous buds were emitted, and these buds all sprang from the spaces and points, which under different circumstances had afforded roots. The tops of the trees last mentioned, having been divided into pieces of ten inches long, were planted as cuttings, and roots were by these emitted from the lowest excrescences beneath the soil, and buds from the uppermost of those above it.

I had anticipated the result of each of the preceding experiments; not that I supposed, or now suppose, that roots can be changed into buds, or buds into roots; but I had before proved, that the organization of the alburnum is better calculated to carry the sap it contains, from the root upwards, than in any other direction; and I conclude that the sap when arrived at the top of the cutting through the alburnum would be there employed, as I had observed in many similar cases, in general buds, and that these buds would be protruded where the bark was young and thin, and consequently afforded little resistance *. I had also proved the bark to be better calculat-

* Philosophical Transactions for 1805.

ed to carry the sap towards the roots than in the opposite direction, and I thence inferred, that as soon as any buds, emitted by the cuttings, afforded leaves, the sap would be conveyed from these to the lower extremity of the cuttings by the cortical vessels, and be there employed in the formation of roots.

Both the alburnum and bark of trees evidently contain this true sap; but whether the fluid, which ascends in such cases as the preceding through the alburnum to generate buds, be essentially different from that which descends the bark to generate roots, it is perhaps impossible to decide. As nature, however, appears in the vegetable world to operate by the simplest means; and as the vegetable sap, like the animal blood, is probably filled with particles which are endued with life, were I to offer a conjecture, I am much more disposed to believe that the same fluid, even by merely acquiring different motions, may generate different organs, than that two distinct fluids are employed to form the root, and the bud and leaf.*

When alburnum is formed in the root, that organ possesses, in common with the stem and branches, the power of producing buds, and of emitting fibrous roots; and when it is detached from the tree, the buds always spring near its upper end, and the roots near the opposite extremity, as in the cuttings above mentioned. The alburnum of the root is also similar to that of other parts of the tree, except that it is more porous, probably owing to the presence of abundant moisture during the period in which it is deposited. And possibly the same cause may retain the wood of the root permanently in the state of alburnum; for I have shown, in a former memoir, that if the mould be taken away, so that the parts of the larger roots, which adjoin the trunk, be exposed to the air, such parts are subsequently found to contain much heart wood. †

I would wish the preceding observations to be considered as extending to trees only, and exclusive of the palm tribe; but I believe they are nevertheless generally applicable to perennial herbaceous plants, and that the buds and fibrous roots of these originate from substances which correspond with the alburnum and bark of trees. It is obvious, that the roots which bulbs emit in the spring, are generated by the sap which descends from the bulb, when that retains its natural position; and such tuberous-rooted plants as the potatoe offer rather a seeming than a real obstacle to the hypothesis I am endeavour-

* This is highly probable and very beautiful; but the extravagant supposition of any fluid possessing life, is not, in the slightest degree, necessary to account for the phenomena. EDITOR. † Philosophical Transactions for 1801.

ing to establish. The buds of these are generally formed beneath the soil; but I have shown, in a former memoir, that the buds on every part of the stem may be made to generate tubers, which are similar to those usually formed beneath the soil; and I have subsequently seen, in many instances, such emitted by a reproduced bud, without the calyx of a blossom, which had failed to produce fruit; but I have never, under any circumstances, been able to obtain tubers from the fibrous roots of the plant.

The tube therefore appears to differ little from a branch, which has dilated instead of extending itself, except that it becomes capable of retaining life during a longer period; and when I have laboured through a whole summer to counteract the natural habits of the plant, a profusion of blossoms has in many instances sprung from the buds of a tuber.

The runners also, which, according to the natural habit of the plant, give existence to the tubers beneath the soil, are very similar in organization to the stem of the plant, and readily emit leaves, and become converted into perfect stems in a few days, if the current of ascending sap be diverted into them; and the mode in which the tuber is formed above and beneath the soil is precisely the same. And when the sap, which has been deposited at rest during the autumn and winter, is again called into action to feed the buds, which elongate into parts of the stems of the future plants in the spring, fibrous roots are emitted from the bases of these stems, whilst buds are generated at the opposite extremittes, as in the cases I have mentioned respecting trees.

Many naturalists * have supposed the fibrous roots of all plants to be of annual duration only; and those of bulbous and tuberous-rooted plants certainly are so: as in these nature has provided a distinct reservoir for the sap which is to form the first leaves and fibrous roots of the succeeding season; but the organization of trees is very different, and the alburnum and bark of the roots and stems of these are the reservoirs of their sap during the winter. † When, however, the fibrous roots of trees are crowded together in a garden-pot, they are often found lifeless in the succeeding spring; but I have not observed the same mortality to occur, in any degree, in the roots of trees when growing, under favourable circumstances, in their natural situation.

I am prepared to offer some observations on the causes which direct the roots of plants in search of proper nutri-

* M. Mirbel's Traite d'Anatomie, &c. Dr. Smith's Introduction to Botany.
† Philosophical Transactions for 1805.

ment, and which occasion the root of the same plant to assume different forms under different circumstances; but I propose to make those observations the subject of a future communication.

A SHORT ACCOUNT OF NECTARINES AND PEACHES NATURALLY PRODUCED ON THE SAME BRANCH.

BY R. A. SALISBURY, ESQ. F. R. S. &c. *

THOUGH it has long been known, that *nectarines* and *peaches* are sometimes naturally produced, not only upon the same tree, but upon one and the same branch, I do not find the fact recorded by any author; and having last year met with two instances, I presume to offer a short history of this anomaly to the Horticultural Society: whether the remarks it has suggested are right or wrong, I leave to be determined by more able physiologists.

The first instance, of which I believe any tradition has been handed down, will be found in a letter of the late Peter Collinson, Esq. to Linne, which was read at the last meeting of the Linnean Society. He there, after giving an account of a supposed adulterous intercourse between two *apple* trees, standing near each other, one of which in consequence bore both smooth and rough fruits, mentions a *peach* tree, that produced *peaches* and *nectarines*.

The second instance occurred in *Yorkshire*, at *Londesborough*, then the residence of the Earl of Burlington; it made so much noise at the time, which was previous to the death of that famous gardener, Thomas Knowlton, as to be visited by the late Dr Richardson, and many other horticulturists of that extensive county.

The third instance is commemorated by a painting of the celebrated Ehret, now in the possession of Messrs Lee and Kennedy: being accompanied with a dissection of the two fruits, which are the *alberge jaune*, sometimes called the *orange* peach: it is very satisfactory.

* Trans. of the Horticultural Society, p. 103.

The fourth instance was noticed more lately in the garden of William Gilpin Esq. *East Sheen;* of this likewise a painting, but without dissections, has been made by Mr Hooker; nor can I from it ascertain the variety.

The fifth instance was discovered early in *June* last, on the wall of Sir John Arundel at *Huntingdon:* having never seen one, I went there immediately, and after detaching the branch carefully from the wall, soon satisfied myself that no bud had been inserted: there was, however, only a single nectarine upon the tree, which the gardener said was the *belle chevreuse*, and a pretty accurate sketch of the branch is annexed. *

The sixth instance was in Mr Wilmot's garden at *Isleworth*, which I also saw in *August* last, and learnt that his tree, which is the *royal George*, seldom fails to produce fruits with both smooth and downy coats, or in fact *peaches* and *nectarines:* two only of the latter then remained, and had been much damaged by snails.

I forbear to recite any others, these being more than sufficient to establish the truth; but my inquiries fortunately terminated with the singular example now before you, of both fruits joined in one. I have to thank Dr Batty for it, who accidentally observed it among a number of *peaches*, sent to him by James Wyatt, Esq. from the neighbourhood of *Hounslow*, during our vacation; and as it was already beginning to decay, this only method of preserving it for your inspection was not neglected.

Most of the gardeners, with whom I have conversed respecting these anomalies, attribute them to the *pollen* of neighbouring *nectarine* trees brought by bees: but, as the young fruit is smooth or downy long before it is impregnated, this cannot be the cause; and, in my humble opinion, no change of this sort is produced subsequently. Not that I have a shadow of doubt of the important consequences which ensue when the *stigma* of one plant imbibes *pollen* belonging to another; but these are only manifested in the succeeding generation. The great Linne, in the *Plantæ Hybridæ* and *Generatio Ambigena* of his *Amœniates Academicæ*, first promulgated a doctrine, which I firmly believe, that varieties, species, and even genera, have been created in this manner; and without the fullest comprehension of it, no gardener can hope to be successful

* On this branch, the bearing wood of which is about a foot in length, there are two peaches, eight inches distant from each other, and between them is a nectarine. A figure is likewise given of the fruit next mentioned, one part smooth, the other downy.

in raising new vegetables, free from faults, or endowed with the perfections he wishes. The pith of Linne's theory is, that the new vegetable will resemble its father, or that from which the *pollen* came, in stem and leaves; but its mother, or that upon which the *stigma* is situate, in flowers and fruit; this idea, which somewhat less restricted has been confirmed by actual experiments, should never be forgotten. Of the necessity of a sexual intercourse, every one who has raised a *cucumber* or *melon* is well convinced, and as far as the annual production of these or other fruits is concerned, I have nothing to hint in addition to modern practice, except that the *pollen* of all vegetables might probably be preserved from one year to another; in early forcing, it would be found very useful, and should be kept in papers as dry as possible, not applying it till the *stigma* is moistened with its own natural exudation. In those countries, where *dates* are the principal food of the inhabitants, a famine would sometimes be the consequence of neglecting this precaution; for the male trees do not flower every year, and it is well authenticated, that *pollen* of this *palm* performed its office successfully, after being sent many miles by the post to *Berlin*.

Other vegetables sport in their pubescence as remarkably as this, but being of less importance, are not attended to. Two years ago I observed a *wall-flower-leaved stock* with both smooth and downy leaves, in Messrs Whitley and Brame's nursery. The common *ling*, of which our besoms are made, varies in the same way; and the *teucrium heterophyllum* takes its name from this very circumstance. I conclude therefore, that all these variations proceed from laws in vegetation, of which we are yet ignorant, but which are immediately connected with the transudation of the sap through the cuticle, and it is possible, that this may even affect the flavour of two fruits upon the same branch.

NOTE ON A SPECIES OF MANNA, OR CONCRETE SUGAR, PRODUCED BY THE RHODODENDRON PONTICUM.*

A FEW years ago Messrs. Fourcroy and Vanquelin remarked, that a concrete sugar, or manna, exuded from the receptacle of the flowers of the dwarf rosebay.

* Annales de Chimio, Vol. LXIII. p. 102.

Mr Bocc has lately observed it afresh, and presented to the institute some grains of this substance collected by him from the receptacle of the fruit, several of which were upward of 2 mill. [0·79 of a line] in diameter. Their taste and appearance do not differ perceptibly from the purest sugarcandy; but it is necessary to be on our guard against this appearance, on account of the deleterious properties suspected in the plant. Mr Deyeux has even found, that they leave an acerb smatch on the palate.

The manna of the rosebay, according to Mr Bosc, is dissolved during the night by the moisture of the atmosphere, melted in the day by the heat of the sun, and does not exude from plants that vegetate vigorously. These are the reasons why it is so seldom seen. Plants growing in pots, and sheltered from the dew as well as from the sun, are most likely to furnish it. The grains above mentioned were collected from a plant, in which all these circumstances united.

Mr Bosc intends, if possible, to collect a sufficient quantity to analyse.

NATURAL HISTORY.

OF A NEW SPECIES OF MOUSE.

BY M. LJUNG.

Mr Ljung, a swedish naturalist, has discovered a new species of mouse, which he has named *sorex caniculatus*. It is the smallest animal known of the mammiferous class, weighing only about half a drachm.

OF A NEW OVIPAROUS QUADRUPED.

BY M. LACEPEDE.

Mr Lacepede has lately given a minute description of an oviparous quadruped, not hitherto noticed by any naturalist,

but preserved in the Museum of Natural History. He classes it in the genus proteus, or that of salamander, distinguishing it by the name of tetradactylus from the number of its toes.

OF A PECULIAR CLAW IN THE BEAVER.

BY M. COSTAING.

On the 17th of November, 1807, during an inundation of the Rhone, a beaver was killed in the island of la Barthalasse, opposite Avignon. Mr Costaing has given a very particular description of the animal, and among other things remarks, that the fourth toe of each hind paw has a double nail, the parts of which close on each other, so as to form a sharp and cutting beak, opening and shutting like that of a bird of prey.

COMPARITIVE ANATOMY.

A LETTER ON A CANAL IN THE MEDULLA SPINALIS OF SOME QUADRUPEDS.

IN A LETTER FROM MR WILLIAM SEWELL, TO EVERARD HOME, ESQ. F. R. S.*

According to your request, I send you an account of the facts I have ascertained, respecting a canal I discovered in the year 1803, in the medulla spinalis of the horse, bullock, sheep, hog, and dog; and should it appear to you deserving of being laid before the Royal Society, I shall feel myself particularly obliged, by having such an honour conferred upon me.

* Philos. Trans. for 1809, Part I. p. 146.

Upon tracing the sixth * ventricle of the brain, which corresponds to the fourth in the human subject, to its apparent termination, the calamus scriptorius, I perceived the appearance of a canal, continuing by a direct course into the centre of the spinal marrow. To ascertain with accuracy whether such structure existed throughout its whole length, I made sections of the spinal marrow at different distances from the brain, and found that each divided portion exhibited an orifice with a diameter sufficient to admit a large sized pin; from which a small quantity of transparent colourless fluid issued, like that contained in the ventricles of the brain. The canal is lined by a membrane resembling the tunica arachnoidea, and is situate above the fissure of the medulla, being separated by a medullary layer †: it is most easily distinguished where the large nerves are given off in the bend of the neck and sacrum, imperceptibly terminating in the cauda equina.

Having satisfactorily ascertained its existence through the whole length of the spinal marrow, my next object was to discover whether it was a continued tube from one extremity to the other: this was most decidedly proved, by dividing the spinal marrow through the middle, and pouring mercury into the orifice where the canal was cut across, it passed in a small stream with equal facility towards the brain (into which it entered), or in a contrary direction to where the spinal marrow terminates.

By many similar experiments, I have since proved, that a free communication of the limpid fluid, which the canal contains, is kept up between the brain and the whole extent of spinal marrow. I have consulted the most celebrated authors on comparative anatomy, but do not find any such structure of those parts described; and as it is not known to you, I may presume, that it has not been before taken notice of.

* This is not a correct mode of reckoning; for the cavities of the Caruncule Mammilares are not properly distinct ventricles, but rather productions of the lateral ones, as those of the Nates in birds are productions of the Aquæductus Sylvii. These cavities are much simpler in their structure, and altogether different in nature, from those properly termed ventricles. They are indeed mere appendages of them, and derive from them their utility. EDITOR.

† Not by a medullary layer, but by numerous transverse medullary filaments which are the commissures of the anterior or ascending columns of the Medulla Spinalis. EDITOR.

ANATOMY AND PHYSIOLOGY.

REPORT ON A MEMOIR OF DRS GALL AND SPURZHEIM, RELATIVE TO THE ANATOMY OF THE BRAIN.

BY M. M. TENON, PORTAL, SABATIER, PINEL AND CUVIER.

With Critical Observations. By the Editor.

Under a despotism so degrading to humanity as that of France, the sciences and the arts cannot possibly flourish. The genius of destruction alone prospers, and fortunately the tyrant is as much its object as the slave. But, in the sciences and arts, no motive, there, excites to originality, and even those persons who, under a happier government, may once have attained celebrity either become stationary in their attainments, or sink entirely under the iron grasp of tyranny. Science and despotism cannot long remain united. Nor do the friends of humanity regret this. It is especially fortunate that, in a country such as France, where contemptible frivolity is the national characteristic—where the minds of men have generally been so imbecile as to deem science useful only in so far as it contributed to the pleasures of 'sottishness or prostitution when seated on a throne', and where the leading scientific assembly at this moment constitutes little more than a set of tools to a conspiracy of inhuman ruffians—it is fortunate, I say, that in such a country, the sciences and the arts have either stood still or disappeared.

Of the truth of this remark, there cannot be a better proof than the paper which I have now to exhibit. Though drawn up by the chief anatomists of France, viz. M. M. Tenon, Portal, Sabatier, Pinel and Cuvier, it exhibits such a deplorable destitution of independance of mind and profoundity of thought, that every philosopher must see, how truly they suffer for that base abandonment which they made of all principle, when, as a collective assembly, they attempted to prostitute science at the feet of a monster whose villany has no parallel

in the history of crimes. On this occasion, it appears, that genius and science fled at the approach of debasement, and left imbecillity and disgrace as the fate of those who would have degraded them.

This paper, however, is worthy of notice, first on account of the importance of the subject, secondly on account of its difficulties, and thirdly because an examination of the reasonings of Tenon, Portal, Sabatier, Pinel and Cuvier, may enable us to attain a more correct mode of investigating the structure and functions of the most interesting organ in the human body and the most important subject of particular physical science.

In order to render the inquiry as distinct as possible, I shall inclose with commas the paragraphs of the French report. My own remarks I shall append to every paragraph that seems to require any, and shall omit none but such as involve no point of importance. Upon the first statement of the doctrine of Gall and Spurzheim also, I shall make no remark, till I criticise the observations of the French anatomists upon each individual head of the doctrine. In short, I prefer criticising the Report on the memoir, to criticising the Memoir itself, because while, in doing so, the memoir is not omitted, a greater number of celebrated names are involved, the merit of which are not, it would appear, to be calculated from their reputation.

'The physical class appointed M. M. Tenon, Portal, 'Sabatier, Pinel and Cuvier, to report concerning a memoir, 'entitled, Inquiries into the nervous system in general, and 'the brain in particular, by Drs Gall and Spurzheim'.

'Your commitee must confess, that they had at first 'some doubts about undertaking its examination'.

'The clsss has always adhered to a very wise rule of 'giving no opinion upon works already submitted in print to 'the great tribunal of the public; and it might be supposed, 'that the anatomical doctrine of Dr Gall has obtained, by 'means of the lectures which he has delivered in the prin-'cipal cities of Europe, and by means of the numerous ex-'tracts from them, published by his pupils, a degree of publi-'city almost equivalent to that of authentic publication.'

'Besides, this anatomical exposition of the nervous sys-'tem is generally supposed to be intimately connected, and 'in fact, is connected to a certain degree, by its author, 'with a physiological [*physiognomical*, they should have said] 'doctrine which he teaches, concerning the [signs of the] spe-'cial functions of the different parts of the cerebral organ, a 'doctrine which in no way comes under the cognizance of the

'class, since it ultimately depends upon observations relative 'to the moral and intellectual disposition of individuals, 'which certainly are not within the sphere of any academy of 'sciences'.

This reasoning is worthy of Frenchmen. Physiognomy ultimately depends upon observations relative to the moral and intellectual disposition of individuals, which forsooth are certainly not within the sphere of any academy of sciences! who taught M. M. Tenon, Portal, Sabatier, Pinel and Cuvier, such an absurd doctrine as this? What are the grounds upon which it rests? Why have they not deigned even to hint at them? It may indeed be, that these *grands philosophes* of the *grande nation* intuitively see the meaning of such expressions. But to me it appears, that all science arises out of observations upon individuals, and that, without these, it could not even exist. History, for instance, is greatly, and Biography entirely, employed in the consideration of individual action, and upon these two sciences depends the whole of morals and of politics. Now it would follow from this sage doctrine of these gentlemen, that morals and politics are not within the sphere of any academy of sciences... We cannot sufficiently reprobate the presumption of men who thus exhibit the utmost superficiality of mind in attempting to deliver general maxims of philosophising—a task for which their countrymen were scarcely ever fit, and in further daring to impose as such the crudest, falsest and most ridiculous assertion... As members of the Mathematical and Physical class of a society which is most awkwardly constituted, they might have pretended to wave this question, but ought most carefully to have avoided delivering such a sentiment as this. Did these gentlemen imagine that their authority or that of the national institute of a country groaning under tyranny, and sinking into barbarism, and which, under the mask of science, is itself a mere instrument of extending conquest, despotism and oppression, was sufficient, without explanation, to impose, as general maxims in philosophy, such crude assertion on the world?... These philosophes never made a more ridiculous error than the present. Almost the very reverse of their proposition is true. It is only by observations on individuals that science can have existence.

'Such were the motives which at first deterred us; but 'others soon occurred which counterbalanced them.'

'Of all that has been written from the lectures of Dr 'Gall, his opinions upon the anatomy of the brain have been 'announced with most confidence, and, at the same time, ex-'plained with least detail and perspicuity. Besides, he does

'not entirely acknowledge any of the publications of his scholars; and consequently none of them enables the public to judge of his ideas, or supersedes the necessity of referring to the memoir presented to you. Lastly, he has taken the greatest care, in this paper, to omit entirely those assertions which have rendered his name popular, by becoming the subject of warm discussion, among people of all ranks, and he has confined himself strictly to his anatomical observations. Whatever, therefore, your judgment may be, no conclusion can be drawn from it, concerning a doctrine which has only a very distant relation to anatomy.'

The conclusion of this paragraph is equally false with the preceding one. The assertion, that physiognomy has only a very distant relation to anatomy, exhibits a degree of ignorance which is perfectly unpardonable in M. M. Tenon, Portal, Sabatier, Pinel and Cuvier. The grossness of their error is most easily shown, Anatomy describes the structure of the body, physiology describes its actions, and physiognomy the effects which these reiterated actions, especially that portion of them termed intellectual, produce upon the structure; thus enabling us, from the structure, to conclude what those operations of mind are which most frequently actuate the individual. When these effects are permanent, they form what is termed the character of the countenance, and when transient, its expression. Thus, in laughter, the angles of the mouth or commissures of the lips are drawn upward, and, in opposite emotions, they are drawn downward. Now anatomy explains the structure of the muscles which perform these actions; physiology explains the motions which they do perform, as well as the general fact that, when any muscle is much employed in any office, it becomes permanently shortened, and even approximates the points into which its extremities are fixed; and physiognomy merely retraces these actions; differing from physiology only in this, that, while the latter describes the actions which the passions &c. induce, physiognomy points out certain forms of the features which are induced by these actions, and which consequently indicate the more or less frequent existence of the passions which invariably excite them. Thus, no two sciences can be more closely connected than anatomy and physiognomy, and the error of these gentlemen is proved.

'The consideration of the importance of the functions of the nervous system, and of the ignorance which still exists, concerning several points of its structure, notwithstanding the numerous examinations to which it has been subjected, super-

'added to these motives, fixed our determination. Whoever 'flatters himself that he is able to throw any light on a subject 'so interesting, and so obscure, is, in fact, entitled to be heard 'with attention, by a body such as ours; and we should be 'wanting in our first duty, if our examinations were not con-'ducted with the greatest attention, and strictest impartiality.'

'Forgetting, therefore, entirely what has been said and 'written for and against Dr Gall, in public, in journals, or 'in pamphlets, not even confining ourselves solely to his me-'moir, which did not appeared to us to have been written with 'all the order and perspicuity to be desired, we invited him, 'as well as Dr Spurzheim, to our conferences. They rea-'dily dissected the brain in our presence, and we dissected it 'before them; we afterwards re-examined, by ourselves, the 'observations they communicated to us; lastly, we endeavour-'ed for a time to adopt their manner of viewing the subject, 'and to give a clear and precise abstract of it, which we 'submitted to them, that they might be satisfied whether we 'had rightly comprehended their ideas.'

'After taking all these precautions, we endeavoured to 'ascertain what was new or just in their ideas, and in the con-'sequences which the authors deduced from them.'

'We now proceed successively to state our abstract, and 'the opinion we have formed.'

'Experience very soon shewed, that the brain is the ma-'terial instrument of the mind, and the essential organ of ani-'mal life, as well as that the whole nervous system performs 'a very considerable part in its functions. It is not, there-'fore, astonishing that physicians, anatomists, and philoso-'phers in all ages, have investigated, with equal ardour, an 'organ of so much importance. It is with its study, that the 'history of anatomy commences and terminates. Democritus 'and Anaxagoras dissected the brain almost 3000 years ago, 'and Haller, Vicq-d'Azyr, and twenty living anatomists, have 'dissected it in our our own times; but, strange to tell, there 'is not one of them who has not left discoveries to be made 'by his successors.'

That, as the first sentence of this paragraph states, the brain is the material instrument of the mind, does not admit of much contest, but that it is *the* essential, or even *an* essential organ of animal life, is utterly untrue; for there are a greater number of animals without a brain than of animals which pos-sess it....Nor is it, as stated in the last sentence, at all strange that discoveries respecting the brain are left to succeeding ana-tomists, when such persons as M. M. Tenon, Portal, Sabatier,

Pinel and Cuvier speak so vaguely and so idly concerning it, as throughout this paper they will be found to do.

'Undoubtedly we cannot expect a physiological explanation of the action of the brain in animal life, like that of the other viscera. In these, the causes and effects are of the same kind. When the heart causes the blood to circulate, it is one motion which produces another motion: when the stomach converts the food into chyle, it is the heat, moisture, gastric juice, and slow compression of its muscular coat, which unite to produce, at the same time, a solution and trituration, greater or less, according to the species of animal, and the nature of its food.'

The assertion in the first sentence of this paragraph, at once exhibits a miserable incapacity, and involves a gross absurdity:—first incapacity, because it has always been the practice of weak men to assert the impossibility of discovering those operations of nature which their own attempts could not explain, and because in truth we find, that human genius and industry is every day rendering plain some of those very operations of which weak persons have previously asserted the inexplicability; and secondly absurdity, because the very assertion that these operations are inexplicable, presumes upon a knowledge of their nature which is at utter variance with the assertion. Thus M. M. Tenon, Portal, Sabatier, Pinel and Cuvier, are at once guilty of weakness and absurdity... In the subsequent part of the paragraph, it is very well stated, that in those actions which I have termed vital, it is one motion which produces another, and even that the causes and effects are of the same kind; but it will be very difficult for them to render it probable that this is not the case in the brain also, and that there one motion does not produce another.

'The functions of the brain are of a totally different order. They consist in receiving, by means of the nerves, and in transmitting immediately to the mind, the impressions of the senses; in preserving the traces of these impressions, and in re-producing them with greater or less promptitude, distinctness and abundance, when the mind requires them for its operations, and when the laws of the association of ideas recall them; and lastly, in transmitting to the muscles, always by means of the nerves, the desires of the will.'

Now here it has at least the appearance of knowledge, that M. M. Tenon, Portal, Sabatier, Pinel and Cuvier, who positively assure their countrymen that they cannot even expect a physiological explanation of the action of the brain in animal life, are at least able to inform them what it is not;

that they can tell them that in it one motion does not 'produce another!' and causes and effects are not 'of the same kind!' But where is the proof of all this? They say, 'the functions of the brain consist in *receiving*, by means of the nerves, and in *transmitting* immediately to the mind the *impressions* of the senses, and afterwards to the muscles the desires of the will,' and yet they say, that, in all this, one motion does not produce another!—that impressions are received and transmitted which they can only be by a series of acts, first in the organs of sense, then in the nerves, and lastly in the brain; for, as in all these, the arrangement of the nervous matter is different, different motions must take place in them; and that yet, there, one motion does not produce another. Now, waving any illustration of the absurdity of their pretension to know that the motions are there less connected than in the other operations of nature, I would ask by what means do these effects succeed each other, if thus unconnected to a greater degree than other physical effects? This evidently these M. M. would find it difficult to answer. As to the doctrine of Hume on this subject, it is evident that they have no wish to avail themselves of it, from their granting that, in the vital actions, one motion does *produce* another; and that doctrine was besides refuted in the last volume of the Archives... But probably it is to the remainder of the process that this strange disjunction of effects refers: they talk of other two things—'the preserving traces of impressions,' and 'the reproduction of these impressions by means of association.' Now suppose we were totally ignorant of this part of the intellectual operation, by what process of reasoning would it follow, that here one motion did not produce another? It on the contrary, however, appears to me, that THE NATURE OF THESE OPERATIONS IS BY NO MEANS SO COMPLETELY HID FROM US; FOR, AS TO THE PRESERVING OF IMPRESSIONS, THE SOFT SUBSTANCE OF THE BRAIN WHICH SO READILY ADMITS OF THEM, IS ADMIRABLY CALCULATED TO RETAIN THEM, OWING TO THE LITTLE VASCULARITY OF ITS MEDULLARY PORTION; AND, AS TO THEIR REPRODUCTION, IT IS OBVIOUS THAT THAT WHICH UNDERGOES FREQUENT OR POWERFUL IMPRESSIONS OF ONE KIND WILL HAVE ITS FORM MODIFIED BY THEIR ACTION, AND WHATEVER NEW IMPRESSIONS OR NEW IMPULSES IT MAY THEN RECEIVE, IT WILL, FROM ITS BETTER ADAPTATION TO THEM, HAVE A TENDENCY RATHER TO REPEAT THOSE ACTS TO WHICH ITS FIGURE IS PERFECTLY ACCOMMODATED THAN OTHERS TO WHICH THAT FIGURE WOULD PRESENT A RESISTANCE. THUS THAT WHICH HAS IN ANY WAY ACQUIRED A CONICAL FORM, WHAT-

EVER MAY BE THE PECULIARITY OF THE IMPULSE UPON IT, WILL TEND TO PERFORM ONE SPECIES OF MOTION, AND THAT WHICH POSSESSES A CYLINDRICAL ONE WILL TEND TO PERFORM ANOTHER: THUS, THE PECULIAR FORMS WHICH FREQUENT IMPRESSIONS PRODUCE WILL UNIFORMLY TEND TO A SIMILAR PECULIARITY OF ACTION; AND THUS, WHATEVER IMPULSES OR IMPRESSIONS MAY BE INFLICTED, THEY WILL, IN THE SIMPLEST MANNER, BE ASSOCIATED WITH THOSE MOTIONS WHICH THE OBJECT IS, BY FREQUENT REPETITION OF THEM, BEST ADAPTED TO PERFORM. NOR CAN IT, IN THIS CASE, BE OF THE SLIGHTEST IMPORT WHETHER THE SUBSTANCE OF WHICH THE FORM MAY BE THUS MODIFIED AND THE ACTIONS THUS ASSOCIATED, BE OF EARTHY, LIGNEOUS OR NERVOUS MATTER. Thus then, even in this—the most difficult part of the process, one motion *does* produce another, and the assertion of these gentlemen is totally unsupported. It appears indeed that, in the present instance at least, they have assumed the air of physiologists, without the slenderest title to the assumption.

'Now these three functions suppose the mutual, but always incomprehensible influence of the divisible matter and the indivisible mind (moi); a hiatus in the system of our ideas never to be supplied, an eternal stumbling-block of all our philosophies. But there is another difficulty not necessarily connected with the former. We not only do not comprehend, and never shall be able to comprehend! how any traces impressed on our brain can be perceived by the mind, and produce images in it; but, however delicate our researches, these traces are in no way visible to our eyes, and their nature is perfectly unknown to us; although the effect of age and of disease upon the memory does not permit us to doubt of their existence, or of their seat.'

Some of our friends will be at a loss to understand by what sort of process it is that, at Paris, the *philosophers* of 'the mathematical and physical class' manage to convert a *hiatus* into a *stumbling-block*. The transformation is certainly an odd one*. There certainly, however, is a considerable 'hiatus in the system of the ideas' of M. M. Tenon, Portal, Sabatier, Pinel and Cuvier. It is, however, a hiatus which has existed in many other minds as well as theirs. Matter, they tell

* I am not, however, sure that, for this metamorphosis, we are not indebted to the ingenuity of the Scottish translator; for, not having beside me, this volume of the Mem. de l'Inst., I have been forced, in some measure, to avail myself of the Scottish version in the Edinburgh Medical and Surgical Journal, after translating it into English by turning *would* into *should*, *will* into *shall* and vice versa, &c. &c.

us, is divisible and mind is indivisible. Now this is a very general proposition, and I as much dislike such propositions, when hastily formed, as they dislike "observations relative to individuals;" and it also appears to me that such 'observations' are more within the sphere of the sapient "academy of sciences" to which they belong, than the sweeping observations which they here pretend to deliver. The truth of this will speedily appear. . . . The divisibility of matter no one will question, but the indivisibility of mind admits of more doubt than these gentlemen seem to imagine. They strangely forget, that although in man the nervous matter is so arranged that, from the intimate relation between all its particles, and their strict dependence upon each other, its functions or mind is indivible, yet, in many species of animals, mind is divisible to a very great degree, and, in others, as the polyp, it is as divisible as the material particles of which the being consists, for it may be divided to infinity, and each particle will still assume its own centre of sensation and volition. As a general proposition, then, this is utterly false, and, with regard to man in particular, the indivisibility is perfectly explicable by means of this single observation, that the divisibility of mind diminishes in exact proportion as the sensorium commune and the intimacy of the relationship of all the parts of the nervous system increase; and hence it is, that, in man, in whom this sensorium commune and intimacy of relationship is very great, mind is least divisible.... But these gentlemen also assert that "the mutual influence of matter and mind is incomprehensible—that we not only do not comprehend it, but never shall be able to comprehend it." Now, in a former note, I have shown that all assertions of the impossibility of our acquiring knowledge are absolutely absurd, because they presume upon a degree of knowledge which the assertors are in the very act of disclaiming. If they be, according to their own confession, utterly ignorant of the subject, how can they possibly tell what difficulties its future investigation shall present? Such assertions, then, of the incapacity of the human mind to develope natural operations always decidedly characterise a mind which is itself either indolent or imbecile. But I must now observe, that this influence is by no means mysterious. In the last volume of this work, I proved that mind consists entirely of the operations of the intellectual organs, and hence it will appear by no means wonderful that an object and its motion are inseparable—the structure of the intellectual organs must peculiarly fit them for the performance of certain actions and the non-performance of others, and on

the other hand, the reiterated performance of certain actions must powerfully modify the form of parts which, by the absorption of old, and secretion of new matter, are, however, slowly undergoing changes throughout their intimate structure. Thus it is, that they are not only intimately connected, but implicitly dependent upon each other:—that matter affects mind, and mind matter, or that intellectual structure affects intellectual action, and intellectual action affects intellectual structure, and thus also it is that M. M. Tenon, Portal, Sabatier, Pinel and Cuvier might have filled up 'the hiatus in the system of their ideas.'

'It seemed, at least, that the action of the nervous system 'upon the organic life, would be more easily explained, as it 'is entirely physical, and that we might expect, by means of 'investigation, to discover in this system some texture, some 'intermixture, or direction of parts which would render it 'more or less analogous to the vascular or secreting organs. 'There was especially no reason to doubt, that it would be 'possible to unfold their different portions, to assign their 'connections, their relations, and respective terminations, as 'easily as in the other systems.'

Here we are annoyed with the useless and unscientific distinctions of Bichat. Man forsooth has more lives than one—an organic as well as an animal life:—it is indeed wonderful that these French physiologists have not invented a new life to explain every phenomenon that has a difficulty connected with it. The vulgar, in order to explain some of their difficulties, invented the eight or nine lives of the cat, and motives, by no means different, induce M. Bichat, and M. M. Tenon, Portal, Sabatier, Pinel and Cuvier, to confer a few additional lives upon man. All attempts to render natural operations more complex have the same origin—ignorance and indolence. This is an important truth and I care not whether it apply to the vulgar or to these M. M.... As to the hope of these gentlemen concerning the facility with which some analogy was to be discovered between the nervous and the vascular system, or that the one would be as easily investigated as the other, it is quite as rational as the rest of their speculations. What analogy is there between the Locomotive and Vital functions? What between bones, ligaments and muscles, and absorbents, blood vessels and glands? None, none. They are destined for different purposes, and no analogy can exist between them. Why then expect such analogy between the vital and intellectual functions?... That men should amuse themselves with such hopes, is idle; and that they should trouble the public with them, is impertinent.

'This, however, has not happened. The texture of the 'brain, of the spinal marrow, and of the nerves, is so fine, so 'soft, that all that has been hitherto said of them is blended 'with conjectures and hypotheses; and the different masses 'which compose the brain are so thick, and have so little con-'sistence, that the greatest dexterity is required to show all 'the parts of their structure.'

Nor was it by any means to be expected that it should have 'happened.' Whatever may have been the hopes of M. M. Tenon, Portal, Sabatier, Pinel and Cuvier, no mere tyro in the science who had once seen the general appearance of the brain would have expected either such an analogy or such facility of unfolding it as in any of the other systems. It is not, however, wonderful that persons who set out with such extravagant hopes should find themselves miserably dissappointed—should become as sceptical of the progress of science and mind as they were previously sanguine respecting it. . . We may at least, however, learn from their errors, to trust them neither in their belief nor in their scepticism.

'In short, none of those who have examined the brain, 'have succeeded in establishing a rational and positive relation 'between the structure of that organ and its functions, even 'those which are most evidently physical; the discoveries hi-'therto made known with regard to its anatomy, are con-'fined to some circumstances regarding the form, connections, 'or texture of its parts which had escaped the observation of 'preceding anatomists; and whenever any one supposed that 'he had proceeded farther, he only introduced, between the 'well known structure and its common effects, some hypo-'thesis, scarcely capable of satifying for a moment even the 'least sceptical minds.'

That this has hitherto been the case cannot be denied, nor is it at all wonderful that this should have been the case with persons who, like M. M. Tenon, Portal, Sabatier, Pinel and Cuvier, assert that "we not only do not comprehend, but never shall be able to comprehend the subject". Indeed such an assertion as this is an apology for the profoundest ignorance, and after it, it is idle for them to dwell on the physiology of this organ.

'All the actual discoveries which have hitherto been made 'may be reduced to new methods of dissecting the brain, new 'connections and directions perceived between its different mas-'ses and the organic elements composing them, or new peculi-'arities observed in some of its parts'.

'We are far, however, from despising these results; they 'direct us to the only route which may at last conduct us far- 'ther! and although we do not yet know the whole length of 'this route, we are satisfied, that every step made in it brings 'us nearer to its termination, by some fraction of its length!'

Now with the views these gentlemen, who would endeavour to investigate a subject the nature of which he was never to be able to comprehend? It is by no means wonderful that the mind, impressed with this opinion, should make fractions small indeed from the 'length of the route', and it is moreover utterly impossible that the members of the 'mathematical and physical class' of 'an academy of sciences', within the sphere of which 'observations on the intellectual character of individuals' do not fall, should ever deduct the minutest fraction from the 'length of the route:' nor is it solely by this route that we shall ever be able to reach the end of the journey,

'We proceed, then, to explain and examine, under these 'three heads, of method, connection and peculiarities, the 'discoveries announced by Drs Gall and Spurzheim'.

'Anatomists know that there are three principal methods 'of demonstrating the brain'.

'The one most generally practised in the schools, and des- 'cribed in books, is that of Vesalius, which consists in re- 'moving successive layers of this organ, and in pointing out 'what presents at every cut. It is the one most easily perfor- 'med for the sake of demonstration, but the most difficult to 'be followed in the mind. The true relation of those parts, 'which we see always cut, escapes, not only the pupil, but 'the teacher; it is almost as if one were to divide the trunk of 'the body by successive sections, to point out the position and 'form of the lungs, heart, stomach, &c. This method, how- 'ever, is still almost the only one which is employed in the 'work of Vicq-d'Azyr, the most splendid, and one of the most 'valuable which has appeared on the subject of the brain'.

'The second mode, which deranges much less the organ, 'the structure of which it is intended to explain, is that of 'Willis, which, as far as we can judge by the obscure des- 'cription of Galen, very much resembles that employed by the 'ancients. After removing the *pia mater*, the posterior lobes 'of the brain are raised, we penetrate between the *tubercula* '*quadrageminа* and the *fornix*, and cut its anterior pillar; after 'detaching the lateral parts of the hemispheres, they are turned 'forwards: in this manner, we have a good view of the under 'part of the *fornix* and *corpus callosum*; we preserve entire,

'the great and small tubercles of the interior; but the thickness of the hemispheres renders it more difficult to practise this mode in man than in other animals'.

'The third method was very long ago sketched by Varolius, and afterwards more fully detailed by Vieussens. By this mode the under part of the brain is first examined, and the *medulla oblongata* is followed across the *pons varolii*, the *thalami optici*, and *corpora striata*; its fibres are seen expanding to form the hemispheres; it is even possible to stretch out the hemispheres by removing their lateral attachment to the crura cerebri; to divide longitudinally the spinal marrow and the cerebellum; and then each half of the former is seen forming a pedicle, which is implanted into the side of the hemisphere, as the stem of a mushroom is fixed into its *pileus*'.

'This mode possesses the very great advantage of allowing us to follow more easily the direction of the medullary fibres, the only circumstance which can afford us any idea with regard to the course of the cerebral functions; and it is probable, that it would have been more generally adopted, if Varolius had not represented it in a very coarse figure, and if the work of Vieussens had not always remained, for what reason it is difficult to determine, in a kind of discredit which it did not deserve',

There can be no question that of these modes the last is the preferable one, when our object is to examine the course of the medullary matter; but this is by no means the only object of the anatomist: it may be his wish to examine the internal cavities of the brain, and then the method of Willis and the Grecian anatomists is incomparably preferable.

'It is nearly this method of Varolius, which is followed by Drs Gall and Spurzheim, and which a part of their memoir is intended to defend; a labour, indeed, very useless, for so complicated an organ as the brain ought to be examined on every side; it must be cut into in every way; and whenever any plan is discovered which points out some new circumstance, it furnishes an important addition to anatomy'.

'We shall therefore judge of their mode by the results; and, for that purpose, we shall detail and compare them with those which have been obtained by preceding anatomists'.

'It is well known, that the opinion most generally received with regard to the minute organization of the brain, is, that the cortical substance of the hemispheres, and of the cerebellum, being almost entirely vascular, is a sort of secreting organ; that the medullary substance, almost every where

'of a fibrous appearance, is a collection of excreting vessels, or 'at least of conducting filaments; that all the nerves are ema- 'nations from this substance, bundles of these vessels; that the '*medulla oblongata*, and spinal marrow, is itself a bundle larger 'than the others, from which the different pairs of spinal nerves 'go off in succession; and lastly, that the nerves called cerebral, 'are the first which go off from the great medullary mass of the 'encephalon; consequently, it is believed that all the influence 'of the nervous system upon organic life, as well as all the 'efforts of the will, descend from the brain along the nerves; 'and that the impressions received from the external senses, 'reascend *by the same route;* but, by a singular contradiction, 'at the same time that they make the medullary substance, 'and, consequently the nerves, originally extend to the whole 'of the cortical substance, several physiologists think them- 'selves obliged to search for some circumscribed place from 'which all the nerves emanate; or, *what signifies the same 'thing*, in which all the nerves terminate; in short, for what 'anatomists call the seat of the soul.'

This is a pretty clear statement of a doctrine which does not only involve contradiction as even M. M. Tenon, Portal, Sabatier, Pinel and Cuvier themselves perceive, though strangely they in some measure embrace it, as the last words in italic show; but which is, from beginning to end, unsupported and absurd.

'It must be allowed, that this has been for a very long 'time the opinion most generally received, and that it is still 'very prevalent; although the most prudent philosophers have 'never brought it forward but as an hypothesis very slightly 'supported by facts.'

'Several of its partizans, however, have allowed them- 'selves to be led into doubts and contradictions. Haller, for 'example, says in one place, that he cannot suppose that me- 'dullary fibres originate any where else than in the brain*; in 'another that every nerve comes ultimately from the medulla 'of the brain or cerebellum †; while, in a third place ‡, he 'supposes that the cineritious matter of the spinal marrow 'may form them in the same manner as that of the brain'.

This last hypothesis can only for a moment be entertained by those who grant the cineritious substance to be a secreting organ—a proposition which, wild in itself and totally unsupported, cannot afford support to any hypothesis which is wilder still.

* Phys. IV. p. 385. † Ibid. p. 398. ‡ Ibid p. 384.

'In fact, this distribution of the cineritious matter in different parts of the nervous system, was one strong argument against the exclusive importance ascribed to the encephalon, and to it might be added several others'.

Perhaps, except M. M. Tenon, Portal, Sabatier, Pinel and Cuvier, no one ever dreamt of this *exclusive* importance of the brain, or thought it necessary to adduce arguments against it. But why the existence, or nonexistence of cineritious matter should be an argument against, or for its exclusive importance, I cannot devise.

'It might be remarked at all times, that the action of the nerves upon organic life continues for some time, after the brain no longer contributes to it. Well known experiments upon insects and worms proved, that if in man, and the other animals where the brain is very large, this organ be necessary to the functions of animal life, it is not always so in those species where it is of less size, and that in some of those we may even instantaneously produce, by dividing it, two centres of volition and sensation'.

It is astonishing that these sapient members of the mathematical and physical class did not recollect this, when formerly they asserted the indivisibility of mind. For as 'observations on the intellectual character of individuals' are so abhorrent to the 'sphere of their academy of sciences', I should have expected that the genus humanum would not have limited their views, especially when the great comparative anatomist and perpetual secretary of the academy formed one of their number. But it is still the idle distinction between what they call organic and animal life which misleads them. That which, in the first sentence, they dignify with the name of organic life is merely those actions of the intestines or blood-vessels which continue sometime after the removal of the brain, precisely because their action is less *immediately* dependent on the brain than that of some other parts, and because that stimulus which intermediately excites them to act—the food, or the blood, remains within them after death, and for a moment produces its usual effects *.

'It has also been known for a very long period, that the spinal marrow does not diminish in proportion to the nerves which go off from it, as it ought to do if it were only a bundle of these nerves sent from the brain; that, on the contrary, it swells at certain places, from whence the largest

* This important fact is amply stated and illustrated in the paper on the intellectual functions in the Second Volume of the Archives.

nerves go off. Prof. Soemmerring has recently remarked, that the size of the *medulla oblongata* in animals is not in that proportion to the brain in which it ought to be, if it were a 'congeries of excretory tubes from the brain, but that, on the 'contrary, it is often in an inverse proportion; the successive 'investigations of Monro, Prochaska, Reil, have given us 'ideas of the structure of the nerves quite different from those 'which we should be obliged to form if we were to derive all 'of them from the medullary substance of the encephalon, and 'by it from the cortical substance. Several physiologists, 'therefore, within these few years, have again begun to con-'sider the nervous system as a net-work, all the portions of 'which contribute, in a certain degree, and especially accord-'ing to their size, to the organization and functions of the 'whole; and not as a tree which, having only one trunk, dis-'tributes itself into branches and twigs, after the manner, for 'example, of the arterial system'.

If M. M. Tenon, Portal, Sabatier, Pinel and Cuvier had thought a little longer, they would have seen that neither of these comparisons were good: while the comparison to a tree and its branches and still more to the arterial system is utterly inadmissible; that to a net-work is vague and inexpressive; it tends even to give an inaccurate notion of the nervous system, and, at the same time, affords no analogy of action. Neither does it appear, as these gentlemen seem to think that 'all the portions of this system contribute, according to their size, to the functions of the whole'. This in the present enunciation is purely hypothetical.

'Drs Gall and Spurzheim, in adopting this opinion, do 'not adduce new proofs of it, but only repeat those which we 'have stated, and which had been brought forward many years 'before'.

'It appears, that in Germany and other places, various 'objections have been made to their system which we should 'not have made, but which they have taken the trouble to 'answer'.

'When they, for example, described, that in the fœtus 'without a head, the nervous system performs its functions of 'organic life without the assistance of the brain, it was oppos-'ed to them, that the acephali are only fœtuses where the 'brain has been destroyed by the effects of dropsy. This ob-'jection, which is true in some acephali, certainly does not 'apply to all; and it is by no means rare to see some which 'have been completely developed, although they do not show

'the smallest mark of having ever had either a head or any of 'the upper parts of the trunk.'

To the general tenor of this paragraph I have nothing to object; but when these gentlemen say, that 'in the acephalous fœtus the nervous system performs the functions of *organic* life,' they forget that the functions of *animal* life are as much performed in it as in all the acephalous genera in which what they term animal life really does exist, as well as the organic—a fact which shows the absurdity of their distinction.

'We therefore readily agree with Drs Gall and Spurz-'heim, with regard to the general idea which they entertain, 'in common with a great many anatomists, respecting the 'nervous system. But while they, with so many others, con-'sider it as a net-work, they have some particular ideas con-'cerning the links and knots of which this network is com-'posed; and here begins the part of their doctrine which is 'peculiar to them.'

On the mere enunciation of the doctrine which follows this, I shall refer all remarks till we arrive at the French critique, when both the original enunciation and that critique will be most advantageously animadverted on.

'As far as we have been able to understand, it appears 'to us, that it may be reduced to the ten following heads or 'propositions:'

'1. The cineritious matter is the *matrix of the medullary 'filaments;* wherever it exists, these filaments are produced; it 'exists wherever they are produced. Whenever a medullary 'bundle crosses cineritious matter, it is enlarged by filaments 'received from the latter, and none of these bundles enlarge 'without the concurrence of this matter, whether it form a 'sensible enlargement, or only follow and accompany the me-'dullary bundle.'

'2. The spinal marrow is not a bundle of nerves de-'scending from the brain. The spinal nerves arise by fila-'ments, some of which ascend, others descend; this is ob-'served especially in brute animals. The cineritious matter 'of the interpart of the spinal marrow is the matrix of these 'filaments; the spinal marrow swells wherever it gives off a 'pair of nerves, and the more the larger that these nerves are. 'Thus the spinal marrow of the larger animals, as well as 'that of insects and worms with red blood, is only a series 'of ganglia which give off nerves; but all these ganglia com-'municate with each other.'

'3. The nerves commonly called cerebral, and which arise 'from the under part of the encephalon, and chiefly from the

'medulla oblongata, do not come from the brain any more than 'the others; on the contrary, when we follow separately the 'roots of each of these into the substance of the medulla ob- 'longata, we see that they reascend from the medulla towards 'the point where they appear externally, and that they do 'not descend from the brain, to pass through the medulla ob- 'longata.'

'4. The brain and cerebellum are themselves only deve- 'lopements of bundles which have come from the medulla ob- 'longata, in the same manner as the nerves proceed from it.'

'The brain, in particular, arises principally from the 'bundles called pyramidal eminences, which cross each other 'in passing out of the medulla oblongata, each going to the 'opposite side to that from which it comes, they swell out 'first in crossing the *pons varolii*, again in passing over the 'tubercles called *corpora striata*, always from the addition of 'medullary filaments, which the cineritious matter, contained 'in these three parts, adds to those they originally consisted 'of. The cerebellum comes from bundles called *processus 'cerebelli ad medullam*, or *corpora restiformia*, which receive 'an addition of filaments once only from the cineritious matter 'of what is called *corpus ciliare*.'

'5. These two pairs of bundles, after receiving these 'additions, after having assumed consequently a diverging di- 'rection, terminate each in two large expansions, covered ex- 'ternally by cineritious matter, which only here deserves the 'name of *cortical* substance; and these expansions, folded in 'various ways, form what are called the hemispheres of the 'brain, the lobes, and the *vermiforum processes* of the cerebel- 'lum.'

'6. From the whole extent of these expansions, other 'medullary filaments are produced, which converge from the 'two sides of the brain and cerebellum, towards the middle 'line, where the filaments of the one side unite with those of 'the other, and form what are called the *commissures*.'

'The corpus callosum, the fornix and its appendages, 'form the largest of the commissures of the brain; the ante- 'rior commissure is that which joins the middle lobes. The 'commissure of the cerebellum is composed of the transverse 'layers of the pons varolii.'

'7. When we remove or lacerate the converging fibres 'which go to the corpus callosum, and which serve as a ciel- 'ing to the lateral ventricles, there only remains, under the 'cineritious substance, a medullary part lining it, and follow- 'ing all its folds; and far from forming a solid mass, as has

'been hitherto supposed, there is always in the middle of 'each convolution of the brain and cerebellum a solution of 'continuity, and by employing proper care, we may unfold 'this portion of the medulla, as we would unfold the cineri-'tious substance if it were alone. In a word, each convolu-'tion is a kind of small purse or canal, closed externally by a 'double layer of cineritious and medullary matter, and on 'the side of the ventricle by the converging medullary fibres.'

'8. As the pairs of bundles forming the brain and ce-'rebellum have their commissures, those which form the 'nerves have often theirs also, which may be very easily de-'monstrated in the second, the fourth, fifth and seventh pairs, 'and very probably in the others.'

'9. The ganglia spread over the whole body are small 'masses of cineritious matter, which certain nerves pass 'through, and where they are strengthened as the pedunculi 'of the brain are increased in the thalami optici and corpora 'striata.'

'These two pairs of tubercles, then, are true ganglia to 'these pedunculi. The cineritious matter of the cortical part of 'the brain and cerebellum may likewise be regarded as a 'ganglion of the commissures, or converging fibres. That of 'the inner part of the spinal marrow forms, in like manner, 'the primary ganglia of the spinal nerve. The cerebral 'nerves have probably each of them a particular ganglion, and 'it is easy to demonstrate it in several of them. The cineri-'tious matter, and consequently the ganglia, may therefore be 'compared to the mucous expansion which covers all the ex-'tremities of the nerves of the skin, of the intestines, and even 'the pulp of the labyrinth, and the sort of mucous varnish 'which covers the retina.'

'10. From these nine articles, all merely anatomical, 'all more or less susceptible of being verified, a tenth results, 'which completes, and is the essential character of the anato-'mical doctrine of Drs Gall and Spurzheim, viz. that each 'pair of nerves forms a particular system; that all these sys-'tems communicate together, and reunite in the great cord of 'the medulla oblongata and spinal marrow; and, lastly, that 'the brain and cerebellum, far from being the origin or source 'of this cord, are, on the contrary, an appendix or sort of *di-'verticulum*, reserved for certain functions, but receiving an in-'fluence from all the parts of the cord, and exercising one 'upon them by means of their communications.'

'We do not think that any anatomist can perceive any 'obscurity in this new explanation of the ten principal articles

'premised by the authors of the memoir which we are examining; they have, besides, acknowledged them to be the true expression of their opinion.'

'It only remains for us, therefore, to say how far they appear to us to be true and new; this we shall do separately with respect to each of them, and with the more interest, as there will result from our examination a kind of treatise, in which the structure of the brain will be considered under different views, more or less important, and abounding with extensive consequences.'

Unfortunately these extensive consequences are, from the inaccuracy of the views producing them, of the worst kind, and these gentlemen need not have picqued themselves respecting their share in the production of them, as will speedily appear.

'But, before proceeding to this, justice requires us to repeat the declaration of Drs Gall and Spurzheim, that they do not pretend to have discovered many new facts; but that the chief merit which they claim consists in the connection which they have been the first to establish between the known facts, and in the general conclusions which they have deduced from them.'

That the first of these claims is unfounded, and that even their conclusions are without merit, will also speedily appear.

'THE FIRST ARTICLE, which ascribes as a function to the cineritious substance the giving rise to the medullary filaments, or, as the authors of the memoir express it, the being the *matrix of the nerves*, is indeed only another expression for the opinion generally received. Disputes have existed with regard to the texture of that substance. Malpighi supposed it to be formed of small follicles; Ruisch, perhaps with more justice, only admitted a vascular net-work; others are of opinion, that there is also, besides the vessels, a particular substance; but it has been almost always agreed to regard it as a secreting organ, and the fibres of the medullary matter as the excreting organs of the substance which it secretes; it was therefore necessary that these fibres should arise from the cineritious matter. The physiologists who do not believe the nerves to be hollow, but suppose that they have the power of conveying a fluid in the manner that the metals conduct electricity, do not all deny, on that account, that the nerves receive their fluid in the cineritious substance; hence they also think that they arise from it. Those, lastly, who ascribe to all the portions of the medullary matter a secreting power, do not pretend to deny, what the eye demonstrates, the close adhesion of the medullary to the cineriti-

'tious matter of the cortical part of the hemispheres, and the 'immense quantity of filaments which go out at so many ra- 'dicles, the cineritious portions of the corpora striata and tha- 'lami optici, &c.'

'Our authors have therefore nothing particular in the 'function which they ascribe to the cineritious substance. 'Even in generalizing this function to all the parts of this 'substance, they only express, in more positive terms, what, 'as we have seen above, Haller suspected to be the case with 'regard to the cineritious portion of the spinal marrow.'

'Since this opinion is admitted by so many anatomists, 'there must be powerful reasons for it; in fact, besides what 'the eye informs us of the intimate connexion of the two 'substances, the number of arteries which go to the cineri- 'tious substance, and which seem almost entirely to compose 'it, can have scarcely any other object than a copious secre- 'tion.'

'The quantity of cineritious matter dispersed over all 'the parts of the nervous system, and to which the authors of 'the memoir have the merit of recalling our attention, would 'perhaps explain sufficiently the functions which the parts of 'the system exercise without the concurrence of the brain, 'and would dispense with the necessity of having recourse to 'a particular power of secretion in the medullary substance, 'or even in the sheath of the nerve, as Reil supposes.'

Now that this cineritious matter is the matrix of the medullary filaments, or the organ by which these filaments are secreted, one or two facts will show to be contrary to all analogy in physiology, and consequently false. On one hand, there is not in the whole body an organ of delicate structure and susceptible of fine motion, which is thus deposited from a vascular mass distinct from itself, or which is not secreted by minute vessels perforating every part of it. On the other hand, all substances, of coarser structure aud insusceptible of motion, except in a mass, and in consequence of impulse from a contiguous organ by which they are either contained, as the fluids by the vessels, or to which they are attached, as the bones to the muscles—all these are deposited from vascular organs more or less distinct from themselves, and either not at all or comparatively little from vessels minutely perforating them. We even find that while in infancy the bones are of more delicate structure, and susceptible of minuter motion, they are secreted by vessels which perforate them minutely, and whenever they acquire a firmer structure and become less susceptible of motion, they are chiefly deposited by the periosteum—a vascular body external to them, as

late experiments have shown. The enamel of the teeth, the nails, the hair, the cuticle and all those parts of the body which never are at any period secreted by vessels minutely perforating them, but by organs distinct from themselves, never are at any period either sensible, or, like the medullary matter, capable of producing the phenomena of sensibility. The supposition, therefore, that the cineritious matter secretes the medullary filaments, is not only unsupported by analogy, but, *contrary* to it, and directly opposed by all the phenomena of secretion.

THUS the FIRST ARTICLE of the Memoir and the corresponding one of the Report are unphysiological, unphilosophical and fall together to the ground.

In the subsequent paper, I shall show that the use of the cineritious matter is to limit the extent and divide the portions of the medullary filaments, so that the actions occurring in one may not, by contact, impede or counteract those of another.

'THE SECOND ARTICLE draws a comparison between the 'spinal marrow of the superior animals, and that of insects and 'articulated worms, or those with red blood.'

'It is well known that, in the two latter classes, the brain 'is scarcely larger than the ganglia, or knots of the spinal 'marrow from each of which the pairs of nerves go off; that 'it is from the size of these ganglia, and from their separation, 'as well as from the smallness of the brain, that we endeavour 'to explain the divisibility of the individual, which is remarked in all these species, at least for some minutes, and which 'goes so far in some, such as the *earth-worms* and the *naides*, 'as to make two lasting individuals from one, by means of 'division.'

'Nothing resembling this had been perceived in man, 'whose spinal marrow has no sensible contraction, and only 'swells out at those places from which it gives off nerves to 'the arms and thighs; but Drs Gall and Spurzheim have 'showed us a preparation of the spinal marrow of a calf, in 'which is observed a kind of slight swelling between each 'pair of nerves. It would be curious to ascertain exactly in 'what animals this structure is found, and if it have any relation to the power of executing certain voluntary actions, 'without the brain; if the turtles, for example, which live and 'walk several months successively without this viscus, have 'the spinal marrow more knotty than the other animals with 'red blood, &c.'

'One of our number has begun inquiries with this intention, which have not afforded him sufficient results to be laid 'before this class; but he has already ascertained that there

'are no sensible knots in quadrupeds even very nearly allied 'to the calf.'

The reasoning by which in this article it is attempted to prove that the spinal marrow of man is a series of ganglia is quite inaccurate. It is as incorrect to denominate the spinal marrow of man a series of ganglia, as it is to term the ganglia of insects and articulated worms a series of spinal marrows. That a tendency toward the formation of ganglia exists even in the calf is so far from being a proof of its existence in man, that it is absolutely an illustration of the very reverse; for it presents to us one of the steps by which an organ forming ganglia in the above mentioned animals, assumes in man precisely the opposite form—a form also leading to correspondingly opposite action. To term this form, therefore, ganglia, is precisely to attempt to trace analogies where nature has abandoned them; for while the ganglia of insects and articulated worms permit the division, without the destruction of these animals, the opposite structure in man produces opposite effects. . . As to the distinction which Gall and Spurzheim are so desirous to draw between the spinal marrow and nerves, it is utterly useless. The nerves, as Prochaska has shown, and as any man may see who has fingers capable of dissecting, and eyes of inspecting, differ from the spinal marrow and brain only in this, that their medullary globules are arranged more regularly in straight lines, and that they are more closely invested by membranes. The nerves, therefore, differ from the spinal marrow in no respect which is not obvious to the eye: in all other respects, they do resemble it.

Thus fall to the ground the reasonings of the Second Articles both of the Memoir and Report.

'The third article is subdivided, for examination, 'into as many heads as there are pairs of nerves.'

'The general result which the authors propose to prove 'is, that all the nerves arise from the medulla oblongata or 'spinal marrow, and not from the brain.'

The falsity of this general proposition will be best shown by showing the falsity of all the details involved by it; and that I shall accordingly do.

'There is no difficulty as to the spinal nerves, which are 'only conjectured to come from the brain, but the roots of 'which undoubtedly no human eye can trace into it, nor even 'perceive a tendency to run into it.'

M. M. Tenon, Portal, Sabatier, Pinel and Cuvier here evidently show themselves to be totally ignorant of the structure of the spinal marrow, the nature of its connexion with the

cerebrum and cerebellum, and the general functions which by these means it performs, otherwise they would have seen that though the spinal nerves are not immediately connected with the brain, they are by means of the spinal marrow intermediately connected with it in such a manner that impressions pass directly through it between them and the brain, and that the spinal marrow serves no other purpose than a nerve would have done in the same situation, although from its being protected by the canal of the vertebræ, and the productions of the cerebral membranes, it requires not the strong and more close investments which the nerves possess in order to protect them in their passage among moving organs....But to prove this. The spinal marrow actually consists of four columns of which two are anterior and two posterior. In the anterior columns terminate the anterior fasciculi of all the spinal nerves, and these columns themselves, passing through the medulla oblongata, crura cerebri, and corpora striata terminate in the hemispheres of the cerebrum. The anterior fasciculi of the spinal nerves are therefore their ascending fasciculi, and the anterior columns of the spinal marrow are, therefore, its ascending columns. From the cerebellum again descend the posterior columns of the spinal marrow, and from these proceed the posterior fasciculi of the spinal nerves. The posterior columns of the spinal marrow are, therefore, its descending columns, and the posterior fasciculi of the spinal nerves are their descending fasciculi. Hence it is that these nerves and almost all the nerves of the body, have filaments of ascending and filaments of descending impression—are at once nerves of sensation and nerves of locomotion. But, although sensation, or the impressions producing it, must ascend toward the sensorium commune, and volition, or the impressions producing locomotion, must descend to the muscles, and although the above facts of structure, which any one may verify, point out the general means by which this may be effected, it may to the above doctrine be objected, that the anterior columns and fasciculi may not, as I have stated, be ascending but descending, and the posterior, not descending but ascending. But that the anterior columns are the ascending ones, is clearly proved by this, that while they pass to the hemispheres, so do the olfactory nerves, and so also do the optic, though by a more circuitous route, as I shall in the sequel show. Now of these nerves we know the impressions must be ascending, for they are nerves of sensation alone. Again, the sixth pair, as well as the posterior columns, passes from the cerebellum, and as that nerve is only a nerve of volition, the motions in it must obviously be descending. Connexion and

analogy, therefore, entitle us to conclude, that the anterior columns and filaments are at once ascending, and the posterior columns and filaments at once descending. Thus, contrary to the assertion of these gentlemen,—without the aid of any conjecture, we prove that spinal nerves both ascend to and descend from the brain, and thus far the authors both of the Memoir and Report are wrong.

'There can be no more with regard to the last pairs of 'the encephalon, counting from the par vagum, and under it, 'for they arise by transverse filaments, as the spinal nerves, 'although they have not two bundles; and no anatomist has 'observed these filaments reflected towards the brain after having entered the spinal marrow.'

'There is still less doubt with regard to the nervus accessorius of Willis, which evidently ascends.'

It is not wonderful that these gentlemen were puzzled respecting the four last pairs of encephalic nerves, and were so easily inclined to abandon them to Dr Gall's decision, since they felt a difficulty even about the spinal. These four pairs have really a more obscure origin than they. None of them, however, need be for a moment left in this entire obscurity.... The twelfth pair, or former ninth, or great hypoglossal, actually does appear, contrary to the assertion of these gentlemen, to have filaments reflected toward the brain after having entered the spinal marrow. But to express this more correctly, this nerve appears to resemble the spinal, in having one connexion with the cerebrum and another with the cerebellum. It sends its cerebral portion upward external to the corpora pyramidalia, and its cerebellic portion descends to it, in some extremely minute filaments, obliquely through the substance of the medulla.... The eleventh pair, or former eighth, or accessory, although externally it appears at once to ascend, yet as it is intimately connected with the origins of the fourth, fifth, sixth and even seventh cervical pairs, it doubtless takes internally the same course with them, and as it is the posterior columns of the spinal marrow which it in general alone joins, we are thence entitled to conclude, that it is, in these cases, a cerebellic nerve alone—that it is a nerve of locomotion but not of sensation, and indeed the general distribution of the nerve confirms this. As to its directly ascending on emerging from the spinal marrow, it is not more wonderful than its general circuitous course, the object of which doubtless is to delay the impulsions which it transmits.... The tenth pair, or former eighth, or par vagum, and the ninth pair, or former eighth, or glossopharyngeal, have also two connexions with the brain; their cerebral portions forming

apparently the fourth medullary fasciculus of the medulla oblongata, or that which is external to the corpora olivaria, and their cerebellic portions descending in the form of a very broad flat medullary band from the posterior part of the cerebellum, in such a manner that it nearly surrounds the medulla. Thus both these classes of gentlemen have erred respecting these four pairs. Respecting the course and termination, however, both of their cerebral and cerebellic portions, I am yet by no means perfectly satisfied, owing to this circumstance, that, though I have lately dissected a great number of brains of various animals, yet, from the heads being often detached close to the situation of these nerves, I have had less opportunity than was to be wished of investigating them. Together with the sixth pair, they are, however, the only encephalic nerves the connexions of which with the cerebrum and cerebellum I am not perfectly satisfied respecting. Meanwhile, having hinted their general course, I leave their further developement to those whose sole business such pursuits ought to be, and some of whom I am inclined to indulge with the opportunity of discovering, because I believe the highest pleasure of life to be derived from it, and because some of them will pretend it is not very difficult. If they should, however, fail in these, or any other point of the same kind, I shall afterwards endeavour to assist them *.

* As, to the great Soemmerring, human anatomy and physiology, and even those parts of comparative anatomy and physiology which are of any use in illustrating the former, owe more than to any other anatomist and physiologist of modern times; and as the origins (as they are vulgarly termed) of the encephalic nerves have been his particular study, I shall, in this and the following notes, make a few remarks upon his descriptions of them in his work De Corporis Humani Fabrica. . . . Of the twelfth and eleventh pairs, he correctly describes the situation when first apparent externally, but he traces them not upward. With equal accuracy, he describes the first external appearance of the tenth pair, but also without tracing it upward. Respecting this nerve, however, he makes a most important remark, which, if he had proceeded with great circumspection, would have enabled him to trace the cerebellic portion of the nerve. He says, ‘ nonnunquam fila quædam ex ipso ventriculo quarto accedunt,’ and afterward, ‘ nonnunquam fila ejus quædam duplicem seriem, et posteriorem, et priorem, more nervorum medullæ spinalis, repræsentat.’ Now this ‘ double series,’ mentioned in the last extract, and which he mistakes for a variety, was, as I myself have seen, nothing more than the cerebellic filaments less accurately joined than usual to the cerebral ones at the point where the nerve is first apparent externally; and the filaments which, in the first extract, he imagined he had, according to his hypothesis, traced to the ‘ fourth ventricle,’ were nothing more than the broad medullary band which these cerebellic filaments form, and which invests the lateral part of the medulla. But minute investigation would have shown Sœmmerring that the course of these filaments gives no support to his hypothesis; that they never reach the fourth ventricle, but bend from it most strikingly upward and forward, and are connected to the medullary part of the cerebellum itself. He also accurately describes the external appearance of the ninth pair, but similarly neglects to trace it upward. The same variety (as he imagined) of passing to the fourth ventricle, or to the posterior crura of the cerebellum, he likewise observed of this nerve, and was similarly misled by the appearance.

'We have only, therefore, to attend to the first eight pairs, reckoning the facial nerve as a separate pair.'

'The *seventh* pair of Willis is, in fact, now generally acknowledged as forming two nerves, distinct at their origin as well as in their course. The soft portion, or the *auditory nerve*, arises transversely from the *corpus restiforme*, called also *processus cerebri ad medullam*. This nerve has been for a long time considered as being formed by the small white filaments traced over the cieling of the fourth ventricle, and this is still the opinion of Haller *, of Vicq-d'Azyr †, and of Soemmerring ‡. However, as these filaments vary in number, and even in direction—as a part of them is sometimes seen reascending towards the corpus restiforme, or passing through it towards the pons varolii §, and as it is not very rare to find them wanting, their continuation in the auditory nerve has begun to be doubted. Prochaska ||, the two Wenzels **, &c. have formally denied it. The latter †† and Dr Gall have farther remarked, that these striæ are generally wanting in animals.'

'The two Wenzels ‡‡ observed, in 1791, for the first time, a small grey band slightly prominent, placed also transversely upon the corpus restiforme, and which constantly covers a part of the base of the auditory nerve, which it unites with the fourth ventricle. Prochaska is hitherto the only one who has given a representation of it §§. It is likewise observed in inferior animals; and Dr Gall, who adopts, in this respect, the opinion of the Wenzels, remarks, that it is the more swelled in every species the larger the ears are, and the more acute the hearing is.'

'In the *horse*, the *stag*, the *sheep*, it is a tubercle almost as large as the eminence called *testis*.'

After mentioning the names of the Wenzels and Prochaska, I need scarcely add, that I have found all these circumstances perfectly correct. The German anatomists form, in my mind, an incomparably more accurate and scientific class of men than the French. Both they, however, and the authors of the Memoir and Report, have failed to trace this eighth pair of nerves, or former seventh, or auditory, to its termination in the brain—its termination,

* Phys. t. iv. p. 225. † Explication des Planches, p. 95.
‡ De Fabrica Corp. Hum. t. iv. p. 256.
§ We have had a very marked example of the latter structure in the course of the researches occasioned by this memoir.
|| Oper. Min. t. 1. p. 388. ** Prod. p. 22. †† Ibid.
‡‡ Prod. p. 22. §§ Oper. Min. t. 1. tab. iii. fig. 1.

I say, for it has only one connexion with the brain, and actually does ascend to the cerebrum by bending around the root of the posterior column of the spinal marrow, descending in the bottom of the fourth ventricle, and joining the crura cerebri, which terminate in the corpora striata and hemispheres. Consistently with this nerve's having only a connexion with the cerebrum and not with the cerebellum, it is entirely a nerve of sensation. Thus the authors both of the Memoir and Report have also missed the origin of this nerve *.

'We have found this circumstance to be true.'

'It is besides evident, that if the origin formerly admitted were the true one, the auditory nerve would not, therefore, arise less transversely from the medulla oblongata, and that its visible roots would always come rather from below upwards than from above downwards.'

This very weak remark scarcely requires any comment, as the real origin of the nerve is above pointed out.

'The *facial nerve*, or portio dura of the seventh pair, and the *abductor* of the sixth pair, are then the first which can leave any doubt, whether they arise from the medulla oblongata, or from the brain, from behind or from before.'

'In man, they both arise from the body of the medulla oblongata, immediately behind the posterior edge of the pons varolii, and so near to it, that several anatomists make them derive a part of their filaments from it.'

'The *facial* nerve, in particular, goes off some lines farther outwards than the other, at the angle formed by the pons varolii and corpus restiforme, at about a line from the point where the *auditory* nerve is detached from the corpus restiforme, which it had, as it were, surrounded.'

This description of the *external* appearance of these two pairs, the seventh and sixth, or the facial and abductor, is sufficiently accurate. It was unnecessary, however, thus to blend them together, and it was a deviation from the arrangement hitherto adopted to describe in detail, as is subsequently done, the sixth before the seventh, since all the previous and succeeding nerves are described in an inverse order.

'The *abductor* seems to arise from the fissure which separates the pons varolii from the pyramidal eminences; and there are some anatomists who derive all its roots from the pons, others from the pyramids, others from both parts.

* It is not necessary to make any remark upon Soemmerring's description of the nerve, since it is properly enough commented on in the text.

'There are others also who are not explicit with regard to 'this point.'

'According to the notion generally adopted, that the nerves 'descend from the brain, M. Soemmerring supposes * that the 'abductor nerve has its roots in the pedunculi, and that they 'separate from them, turning backwards, after the pedunculi 'have crossed the pons varolii to form the pyramidal emi-'nences. This is nearly the opinion of Vieussens †, but it is 'evidently the result of hypothetical reasonings, and not of 'actual observation.'

'To ascertain the true direction of the roots of these 'nerves, it is necessary to have recourse to the herbivorous 'animals, in which the pons varolii does not cover them, 'since it is not so large as in man.'

'This is what Drs Gall and Spurzheim have done, and 'they found at once that the *abductor*, in them, arises some 'way behind the pons varolii, and appears to be the conti-'nuation of a small bundle which ascends between the corpus 'pyramidale and olivare. The filaments which produce it 'are longer at the back part and shorter before, so that they 'have, in miniature, the same arrangement as those of the 'accessorius of Willis. There is no reason, then, to suppose 'that it descends from the brain.'

'This observation concludes the discussion whether or 'not the nerve receives some filaments from the pons varolii; 'since it is only on account of the breadth of the pons in man 'that it approaches to its posterior edge.'

'We have not found any positive traces of this remark 'in the authors whom we have consulted, but we have con-'vinced ourselves that it is true with respect to the herbivo-'rous animals; and one of our number had even observed it 'some time ago in the horse. In the carnivorous animals and 'the ape, the pons varolii and the sixth pair have a greater re-'semblance to what is observed in man.'

With regard to the external appearance of the sixth pair, Gall and Spurzheim are perfectly right; but, in their conjecture, that it is derived from what I should term the second longitudinal fasciculus of the medulla, they are completely mistaken. That its fibres are longer before than behind affords no proof of this, and minute dissection shows the very reverse, —that, contrary to the opinion of these gentlemen, it does descend from the brain. Soemmerring and Vieussens are, however, equally wrong. This nerve has only one connexion

† De Bas. Enceph. p. 140. ‡ Neurogr. Univ. p. 176.

with the brain, and that is with the cerebellum; consistently with which it is entirely a nerve of locomotion. This origin is from the root of the posterior column of the spinal marrow, or posterior peduncle of the cerebellum, from which it descends in very fine filaments through the medulla oblongata to the externally apparent origin of the nerve. Thus the authors both of the Memoir and Report have erred respecting this nerve *.

'With regard to the *facial nerve*, a transverse medullary 'band is seen in the herbivorous animals, behind the pons va- 'rolii, which begins exactly at the outer edge of the abduc- 'tor, and passes over the root of the *par trigeminum*, or where 'it is continuous with the auditory nerve. The facial nerve 'appears to pierce the band obliquely from behind forwards. 'Thus it would seem to arise from the under part of the me- 'dulla oblongata, almost in the same manner as the auditory 'nerve arises from the upper part, and two pairs of nerves 'would be formed, the origins of which are, in fact, separated 'from each other by the whole thickness of the medulla ob- 'longata, although they afterwards approach so as to touch 'each other.'

'Nor have we remarked, that any author has pointed out 'this fact before Dr Gall; but we are certain of its accuracy, 'and one of us had seen it, and delineated it some time ago, in 'the stag, horse, sheep and rabbit.'

With regard to the seventh pair of nerves, then, or the facial, these gentlemen, as in their account of most of the rest, describe only the externally apparent origin, and go no deeper than the surface. Not only are M. M. Tenon, Portal, Sabatier, Pinel and Cuvier, contented to admit the description of Gall and Spurzheim, but they tell us they are certain of its accuracy, and even seem inclined to claim it themselves, or to ascribe it, in their own language, to 'one of us.' As, however, they appear, upon the whole, to ascribe the *discovery* to Gall and Spurzheim, and the mere *delineation* to 'one of us,' it follows (much to the honour of this sage member of the mathematical and physical class) that he did not know what he was delineating! When men make such blunders, they become ridiculous, and when they do so from a wish to share the supposed merit of others, contemptible. But the most curious circumstance is, Gall and Spurzheim are grossly mistaken—grossly mistaken, in spite of these M. M. being 'certain of its accuracy;'—grossly mistaken, in spite of 'one of us' having delineated it! and if they, or any other

* As Soemmerring's description of this nerve is also referred to in the text, it requires no further notice here.

persons, are desirous of beholding the real course of the nerve, THEY NEED ONLY MAKE, CLOSE TO THE SIDE OF ITS EXTERNALLY APPARENT ORIGIN, A LONGITUDINAL INCISION, THROUGH THE MEDULLA, TOWARD THE FLOOR OF THE FOURTH VENTRICLE, AND THEY WILL, THEN, SEE IT TO BE THERE ABOUT THE THICKNESS OF A CROW'S QUILL! STRONG, SHINING, AND FORMED OF TWO PERFECTLY DISTINCT CORDS! THE SEVENTH PAIR OF NERVES, THEN, HAS TWO PORTIONS, BOTH THUS ASCENDING, AS IT IS COMMONLY TERMED, THROUGH THE SUBSTANCE OF THE MEDULLA, IN CLOSE CONTACT, AND BEING, IN THEIR COURSE, INCLINED TOWARD THE CENTRE OF THE SUBSTANCE THROUGH WHICH THEY PASS. OF THESE CORDS, ONE IS ANTERIOR AND RATHER THE LARGEST; THE OTHER POSTERIOR AND RATHER LESS. BOTH REACH A SMALL PIT SITUATE SOMEWHAT LATERALLY IN THE BOTTOM OF THE FOURTH VENTRICLE, AND, THERE, THE ANTERIOR PASSES FORWARD TO THE CEREBRUM; THE OTHER BACKWARD TO THE CEREBELLUM: THE ANTERIOR IS THEREFORE ITS CEREBRAL; THE POSTERIOR, ITS CEREBELLIC PORTION; and, consistently with this, the nerve is at once one of sensation and one of locomotion. Thus both these German and French anatomists were ignorant of the origin of this nerve, and may learn the impropriety of talking with such 'certainty' of their 'accuracy,' when either they had not investigated, or had neither fingers nor eyes capable of it; for from one or other of these causes their failure must have arisen, as it will give me pleasure to demonstrate on the subject to any ardent investigator of this interesting department of science *.

'The brute animals also, show more clearly than in man, 'the origin of the *par trigeminum*, or fifth pair.'

'It is generally said simply to arise from the lateral parts 'of the pons varolii, or from the extremity of the pedunculi 'cerebelli. This is still adhered to by Vicq-d'Azyr † and 'Meckel ‡. Haller reckons this pair in the number of nerves, 'which may come both from the cerebrum and cerebellum §. 'It is however ascertained, that it neither comes from the one 'or the other, and that it may be traced deep into the medulla 'oblongata, to nearly an inch farther back than where it comes 'out.'

'Santorini asserts ||, that he has traced the roots of it to 'above the corpora olivaria, and says, that it is not more

* Of this pair, Soemmerring observed the division into two portions externally, but was also unaware of its internal course.

† Explication des Planches, p. 52. ‡ No. 46. et 47.

§ Phys. t. iv. p. 387. || Observat. Anatom. p. 64, 65.

'astonishing to see this nerve ascend from below, than the *accessorius of Willis;* but he then supposes, that a part of the fibres of the pedunculi, which do not enter the corpora pyramidalia, they being in fact too small to contain them all, go on further, and then, among others, are reflected those which form this nerve; a very gratuitous supposition, and which nothing sensible to the eye can justify.'

'M. Soemmering seems not to have understood Santorini, at the time he wrote his treatise *De basi encephali;** but he relates, that † accident had made him afterwards trace the origin of this nerve into the substance of the medulla oblongata, even as far as the bottom of the fourth ventricle; and according to his favourite hypothesis, with regard to the seat of the soul, he conceives that the primary roots of it are bathed in the water of that ventricle.'

'Dr Gall follows, in a steady and sure manner, this deep and low origin of the par trigeminum, as far as between the *corpora olivaria* and *restiformia.* He shows besides, that the breadth and thickness of the pons varolii in man, were the obstacles to its being discovered sooner. In fact, in the herbivorous animals, in which the pons is much narrower, the roots of the trigemini are easily traced, under a part of the pons, and under the transverse band placed behind, which we have seen to be partly the origin of the facial nerve, as far as a longitudinal bundle which runs along the outer side of the corpora olivaria.'

'We have confirmed these two observations; and in repeating the second, in several animals, we have ascertained that it is found neither in the ape, nor in several of the carnivorous animals in which the nerves go off as in man; but always because the pons varolii in them also is broad. With regard to the first, it has appeared to us to be so certain, that we cannot help saying that Vicq d'Azyr has been deceived, in deriving the roots of the fifth pair from the pedunculi cerebelli ‡. In examining always with the knife, he must have divided them, and lost sight of them too soon.'

Neither Vicq d'Azyr nor Meckel were in the slightest degree deceived in deriving certain roots of the 5th pair from the peduncles of the cerebellum, and this perhaps is the only portion of any encephalic nerve which has hitherto been correctly traced, even in one of its portions. The fact is so obvious as to admit of no contest, and can only have been doubted by

* P. 135. † De fabric. corp. hum. p. 212. No. 7.
‡ Mem de l'Acad. des Sciences, 1781. p. 565.

these gentlemen because they thought Drs Gall and Spurzheim had pointed out another origin, as it is termed, and because they were also of opinion that the nerve could not have two. Soemmering, on the other hand, neglecting this division of it, appears to have traced for some way its cerebral portion. It does not, however, as he asserts, terminate in the bottom of the 4th ventricle, but there joins the anterior or ascending columns of the spinal marrow, and with them consequently ascends to the hemispheres. Consistently with its having two portions, it is a nerve both of sensation and locomotion. The substance which the German and French anatomists imagine to be the origin of this nerve is a portion of one of the lateral fasciculi of the medulla oblongata which ascends by the side of the nerve, but is easily distinguished from its roots. Thus these anatomists have erred respecting the origin of this nerve *.

'Every one knows, that the *nervus patheticus*, or the fourth 'pair, arises transversely from the valvula Vieussenii, behind 'the *testes*. There is nothing which could make it be derived 'from the great medullary mass of the brain.'

'Tout le monde sait' is a French, and generally neither an English nor a correct mode of, expression. This nerve, instead of arising always transversely as these anatomists say, arises rather obliquely from the valvula Vieussenii; frequently even derives oblique filaments from the posterior part of its surface; and indeed seems to me to have the whole valve as its cerebellic origin, for the valve runs back till it terminates in the medullary substance of the cerebellum †. But this is not its only origin, as it is vulgarly called; and although 'tout le monde' may think that there is nothing which could make it be derived from the great medullary mass of the brain—although M. M. Tenon, Portal, Sabatier, Pinel and Cuvier may also be certain of this—and (which is more important) although it may even appear contrary to analogy that it should be so, yet this nerve, which appears to be only a nerve of locomotion, has a cerebral as well as a cerebellic portion. Its cerebral portion runs to the posterior part of the testis, and by a careful observer may be seen very distinctly without any dissection, and by dissection may be traced deeply under it towards the

* As Soemmerring's description is noticed in the text, no remark on it is here necessary.

† The Frenum, however, of the valvula vieusenii seems entirely to consist of the Cerebellic origin of the 4th Pair passing from the posterior peduncle of the Cerebellum of the opposite side, forward along the margin of the 4th ventricle.

crura cerebri. Thus both these German and French anatomists have erred respecting the origin of this nerve also *.

'The *motor oculi*, or third pair, comes from the pedunculus cerebri, towards its internal edge, where it touches the *perforated cineritious space*, lying between the two pedunculi and the two processus mamillares, and receives some filaments from it. In man its roots are arranged in a line, nearly in the direction of the pedunculi, and the posterior roots are the longest, judging even by the external appearance; they proceed then rather from the posterior than the anterior part; but if a slight cut be made into the peduncle, this fact becomes still clearer. The greater part of these roots may be followed as far as under the pons varolii. A part of them is lost, or rather is formed around the black coloured part of the pedunculi. This arrangement is very well represented by Vicq d'Azyr, *pl. xxxi. fig.* 2.'

'In other animals, the roots are more transverse, and more perpendicular; such at least we have observed them to be in the horse and the sheep.'

Of this nerve, one origin is correctly traced as far as the pons varolii; though it certainly never passes 'under †' or superficial to the pons, but, on the contrary runs above it and along its inner side to the medulla of the cerebellum. These anatomists, however, are ignorant of the most extraordinary and most remarkable portion of this nerve. ITS CEREBRAL PORTION ACTUALLY PASSES UPWARD AND SLIGHTLY FORWARD BETWEEN THE CRURA CEREBRI, SO THAT, AT ITS UPPER PART, IT RUNS ALONG THE POSTERIOR SIDE OF THE THALAMUS CONSIDERABLY BEFORE THE POSTERIOR COMMISSURE, AND TERMINATES IN THE POSTERIOR PART OF THE PEDUNCLE OF THE PINEAL GLAND CLOSE TO THE GLAND ITSELF. If M. M. Tenon, Portal, Sabatier, Pinel and Cuvier will make a longitudinal and perpendicular incision through the crura cerebri, close to the externally apparent origin of the nerve, this important fact will be as obvious to them as it is, at this instant, to me ‡. This cerebral cord is nearly as thick as a crow's quill, and, at its termination in the peduncle is dispersed into several filaments §. Thus these French and German anatomists are entirely ignorant of the cerebral, and have erred respecting the

* Soemmerring's description of this nerve differs not materially from that usually given.

† It is probable that here the Scottish translator has mistaken the *sus* for *sous*.

‡ It will give me pleasure to demonstrate, upon the subject, this or any other of these facts, to any gentleman zealous in these pursuits.

§ The fibres forming the external origin of the 3d pair of Nerves, are arranged in such a manner that they form 2 sides of a square, one side being posterior, the

cerebellic portion of this nerve *, for, consistently with its two functions of sensation and locomotion, it has both.

'The *optic nerve* is very generally considered as proceeding from the thalami optici; because its roots are spread out upon them in the manner of a thin membranous expansion, which almost entirely covers them. However, anatomists have not been wanting, who supposed that they could trace at least a great part of these, as far as the *nates*; such as Morgagni, Winslow, Zinn. Santorini † describes this origin very carefully, and adds another, which he makes to come from the testes; his pupil and editor, Girardi, confirms it ‡. Vicq d'Azyr, who was also very well acquainted with these connections of the optic nerves with the tubercula quadrigemina, pretends, however, that they have likewise other roots in the substance of the thalami, which, in the form of innumerable filaments, join the nerve in a great part of the course which it takes in surrounding the crus cerebri; and he boasted of this discovery §. But this appears to us to be a deception, into which he may have been led by his mode of making parallel incisions. It is very true, that a number of white filaments arise from the cineritious substance of the thalami; but they do not appear to us to go to the optic nerve. On the contrary, they are added to the bundle which comes from the pyramidal eminences, as we shall mention presently. Drs Gall and Spurzheim have found out a mode of dissection which demonstrates this very well, and which we shall mention again.'

'They suppose then that it is possible, at least in several animals, to remove from above the thalami, without affecting them, the medullary expansion of the roots of the optic nerves, and to follow them as far as the internal part of the nates, where they form a white lamina which occupies the centre of these tubercules.'

'The last point is certain; with respect to the first, as it can only be performed with the assistance of the handle of the scalpel; it is liable to the same doubt as all similar operations which may be tried on the brain.'

other internal—the internal series of fibres evidently leading to the Cerebral origin of the Nerve—the Posterior series to the Cerebellic. This fasciculus of Medullary fibres passes from the posterior and rather external part of this Nerve toward the Pons Varolii, appearing superficially on the Crus Cerebri.

* Soemmerring errs entirely in saying this nerve arises from the crura cerebri; and when he speaks of its being distinguishable 'fere ad pavimentum ventriculi tertii,' he mistakes for it the radiating striæ of the crura themselves.

† Observat. Anatom. p. 63.

‡ Septemdec. tab. p. 34.

§ Acad de Sc. 1783. p. 529.

'Our anatomists farther remark, that in those individuals 'in which the optic nerve of one side is weakened and thinner, 'the corresponding tubercle is also smaller; and that in those 'species which have large optic nerves, the nates are of larger 'size; but that frequently in these cases the thalami are 'smaller.'

'The medullary tract which comes from the nates, meets 'in its course the tubercle called *corpus geniculatum externum*'.

'That which comes from the *testes*, divides the first at 'the *corpus geniculatum internum*, and seems to slip under it, 'to cross it in passing forwards; thus Drs Gall and Spurz-'heim do not believe that it belongs to the optic nerve; they 'have even for a long time thought that it forms the external 'root of the *olfactory*, which is indeed very nearly in that di-'rection; but they have never been able to trace its conti-'nuity'.

'One of our number has made several researches on this 'part of the brain, which appears to have been only well 'known to Santorini and Vicq-d'Azyr, but which has never 'been properly delineated'.

'It is a fact, that in all quadrupeds, the principle bundle 'of the optic nerve goes from the nates to the *corpus genicula-'tum externum*'.

'It is also certain, that another bundle comes from the 'testes, which makes an angle with the first; and which, af-'ter swelling out to form the *corpus geniculatum internum*, 'seems to pass under the first bundle, and proceed further, 'but is soon lost to the eye and the knife'.

'*Lastly*, it is ascertained, that both the *testis* and the *cor-'pus geniculatum internum*, are much larger in the carnivorous 'than in other animals; and this fact would be favourable to 'the idea, that they contribute to form the olfactory nerve 'which is so conspicuous in that class'.

'But we think that we have seen in the ape, that the *cor-'pus geniculatum internum* receives a bundle from the *nates*, as 'well as from the *testes*, and forms by their reunion a root of 'the nerve, which joins only very low down that which comes 'as usual from the nates above the *thalamus opticus*. Drs Gall 'and Spurzheim have themselves besides remarked, what 'one of us pointed out long ago, that dolphins and porpoises 'which have no olfactory nerve, have, however, very con-'siderable *testes*'.

'These animals, likewise, have the corpora striata as the 'others, which shows that these bodies do not possess the 'function attributed to them, of forming the olfactory nerve'.

'The first pair, then, will be the only one, the roots of 'which cannot yet be traced to the medulla oblongata, and 'which does not agree as yet clearly with the rule established 'in the memoir which we are examining'.

'Dr Gall explains, conformably to the law mentioned 'in his first article, the enlargement of the optic nerves below 'their conjunction, by numerous filaments sent to them by the 'cineritious lamina interposed at the fore part of that conjunc-'tion; which filaments have been accurately described, and 'carefully delineated, by Vicq-d'Azyr *'.

'A strong objection was made to the origin, which our 'anatomists assign to the optic nerve, drawn from the struc-'ture of birds, which, it was said, have no *nates*, although 'their eye and optic nerve are of a very large size; but their 'answer is convincing. What Willis, Collins, Haller, and 'other anatomists have called thalami optici in birds, is in 'fact the *nates*. The true thalami optici are situate before, 'with their third ventricle, the pedicles of the pineal gland, 'and the two commissures in their usual place; in a word, 'they are in every respect similar to those of quadrupeds, 'in proportion to their relative size; the supposed thalami of 'Haller are, on the contrary, between the posterior commis-'sure and the valvula Vieussenii; the aqueduct of Sylvius 'passes between them; it is with it that the ventricles com-'municate, which are peculiar to them in this class'.

'We have proved the truth of this important remark; it 'can admit of no reply. It is the more the duty of the repor-'ter to acknowledge it, as he had adopted the common error 'in his works'.

'Now as the tubercles in question evidently give rise to 'the optic nerves in birds, they confirm the origin which they 'ascribe to these nerves in the mammalia, and in man, instead 'of invalidating it'.

'We may here repeat the elegant remark made by Vicq-'d'Azyr, that these tubercles have a ventricle in birds in 'which the sense of sight is the most acute, as the olfactory 'nerves in the mammalia, in which the sense of smell is su-'perior to the others'.

The shortest and best criticism which, I believe, I can make on the three preceding pages respecting this important nerve is to describe that which I have found to be its real course. The nerve of each side, without receiving filaments from the

* *Mem. de l' Acad.* 1783. p. 548. et pl. xiii. fig. 1. et 2.; and in his large work pl. xxi. in all the figures.

thalami reaches the nates, then crosses to the opposite testis by means of the strong white cord between them posteriorly, and lastly, by the medullary tract of the corpus geniculatum internum, descends to the Crura Cerebri, reaching thus the hemispheres of the cerebrum like the other encephalic nerves. It has no cerebellic ortion which is consonant with its being entirely a nerve of sensation. Thus these German and French anatomists have also erred respecting this nerve *.

'We proceed to the FOURTH ARTICLE, in which our authors explain the relation between the medulla oblongata, and the brain, and the cerebellum'.

'The continuity of the medullary fibres of the pyramids across the pons varolii, with the crura cerebri, and of these across the *thalami optici* and *corpora striata*, into the medullary substance of the hemispheres, was well known to Vieussens, who had also given the very just appellation of posterior corpora striata to the thalami optici; but the figures †, in which he represents this important point of the anatomy of the brain are very coarse; they only show simple filaments, which went on enlarging and saparating from each other, which is far from being the case.'

'This interesting point of view was afterwards almost entirely overlooked, because they contented themselves with cuts made in the superior part of the brain. Monro ‡ and Vicq-d'Azyr || again introduced it; the latter especially represented this continuity in two very beautiful plates, although, perhaps still a little less exact than is necessary, because the preparer had not taken care to bend his incision according to the direction of the filaments.'

'To these horizontal incisions already made by the three authors we have just quoted, Drs Gall and Spurzheim add a vertical one, which has the merit of explaining, according to their view, how these medullary bundles enlarge, and of pointing out the true termination of the filaments of the thalamus opticus, which Vicq-d'Azyr thought he had traced into the optic nerve.'

'This cut passes through the middle of the pyramidal eminence of the crus cerebri of the thalamus and corpus striatum of one side, obliquely forwards and outwards.'

* With regard to this nerve, Soemmerring errs in not perceiving the peculiar course which its fibres take, but in ascribing to it a complex and most ridiculous origin, at once from the Thalami, Corpora Geniculata, Nates and Testes.

† Nevrogr. univ. p. 88. et 89.

‡ Nervous System, t. VII. fig, 1.

|| Grand ouvrage sur le cerveau pl. XXII. et XXIII.

'The bundles of the pyramids are there distinctly seen 'intermixing with those of the pons varolii, and with the ci- 'neritious substance which mixes there with them, and sup- 'plies some additions; passing from thence into the crus ce- 'rebri, they again receive filaments from the *processus cerebelli* 'ad testes. At one place, under the thalamus opticus, they 'unite into a white mass, to which innumerable filaments of 'the internal part of the thalamus are joined at acute angles, 'pointing forwards. It is essential to remark the latter cir- 'cumstance; it proves that the thalami send their filaments 'forwards and not backwards, as Vieussens had supposed; it 'points out also, that it is not into the optic nerve that these 'filaments go, as Vicq-d'Azyr thought.'

'The white mass then becomes stronger, and divides in- 'to a great number of diverging pillars, which constitute the 'white streaks of the middle of the corpora striata; the cine- 'ritious matter of the superior surface of these bodies gives al- 'so a great number of small filaments, as the thalami had 'given; at last, all these fibres are dispersed in the medullary 'mass of the hemispheres, where we shall follow them pre- 'sently.'

'The two tranverse whitish arches which are seen in the 'horizontal cut, and part of which Vicq-d'Azyr has expres- 'sed in his plate, are the places to which the greater number 'of filaments come from the superior parts of the thalami and 'corpora striata.'

'Such is the faithful description of what is perceived by 'the eye; one of us has delineated all this arrangement in man, 'quadrupeds, and birds, in which the essential points are 'nearly the same.'

'We are aware that there is no better reason for saying 'that the great fibrous bundles go from the pyramids to the 'hemispheres, than from the hemispheres to the pyramids; 'since the nervous influence proceeds in both directions.'

'But one may and ought to inquire which direction the 'small fibres of the thalami and corpora striata take. Are 'they supplied by these tubercles to enlarge the great medul- 'lary bundle, or are they given off from the medullary bundle 'to sink into these tubercles? This latter opinion certainly 'could have no probability, and no one will condemn Drs 'Gall and Spurzheim for adopting the opposite opinion.'

'They would then be in the right in this sense, when 'they say that the medullary bundles go on always enlarging 'from the pyramids to the hemispheres.'

'But whence do the inferior extremities of the bundles, 'these same pyramidal eminences, come; or, whither do 'they go?'

'They cross each other about two finger's breadth behind 'the pons varolii, and immediately disappear behind that point 'losing themselves on both sides in the two cords composing 'the inferior surface of the spinal marrow.'

'This is one of the most interesting facts in physiology 'and pathology.'

'Every body knows how frequent it is to see a paralysis 'of one side, occasioned by an injury of the opposite side of 'the brain; physicians of every age have endeavoured to ex- 'plain this fact by a decussation which they vaguely supposed 'in the fibres of the brain, or in the deepest roots of the 'nerves *.'

'However we see, almost every where, only transverse 'fibres, commissures, and not crossed fibres.'

'There is only one place, at the posterior extremity of 'the medulla oblongata, which presents a true decussation 'which was discovered by Domenico Mistichelli, and very 'well described by him in 1709 †. François Pourfour du 'Petit ‡ likewise described it in the following year, and was 'the first who made it known in France.'

'How has it happened that a point of structure so evident, 'adopted by Winslow *, Lieutaud † and Portal, distinctly de- 'scribed ‡, and plainly delineated § by Santorini, should have 'been doubted by the great Haller ||, recently denied by very 'skilful men, and confounded by others, among whom may 'be reckoned Vicq-d'Azyr himself, with that of the trans- 'verse fibres which reunite, in their whole length, the lateral 'parts of the medulla oblongata?'

'It is probably owing to the want of a sufficiently clear 'description, and perhaps, also, because the place of the de- 'cussation must be often cut in separating the head from the 'body.'

* Arétée de Caus. et Sig. Morb. lib. 1. cap. 7. p. 34. B, edit. Lugd. Bat. 1731. Nervi ab initio enati protinus ad oppositos transeunt, se invicem permutantes in figuram literæ X.

† Trattato dell Apoplessia, Roma, 1709. in 4to.

‡ Lettre d'un Medecin des Hospitaux du Roi, p. 12. Namur, 1710, 4to.

* Traité de la Téte, No. 110.

† Anatomie Historique et Pratique, t. 1. p. 591.

† Santor. Observ. Anatom. p. 61. xii.

§ Ibid. § xvii. tab. II.

‖ Phys. t. iv. p.

'It will be impossible to be mistaken in it, after the demonstrations of Drs Gall and Spurzheim. When we separate from each other the two inferior cords of the medulla oblongata and spinal marrow, we see that they are separated by a pretty deep fissure, the bottom of which is occupied by transverse medullary filaments. This fissure is only interrupted at one place, which is what now engages our attention, and which is only two or three lines in length. The fibres of the pyramidal eminence of one side form there three or four filaments, which decussate upon the fissure with the opposite filaments, as the hairs of a mat, and which are blended afterwards with the rest of the medullary cord, into which they must enter obliquely.'

'This decussation strikes the eye when we separate gently the edges of the longitudinal fissure of the medulla oblongata, because it is the only place where we cannot perceive the bottom of the fissure.'

'There is certainly some merit in having renewed the general knowledge of an important point of doctrine, which the doubt or denial of able men had caused to fall into oblivion.'

'Dr Gall having established, as it appears, from this progression of medullary bundles of the brain across the pons varolii, the thalami, and corpora striata, his law of the increase of the medullary fibres by the cineritious substance, wishes to apply it to the cerebellum'.

'He has recourse here to the cineritious body of so singular a figure, which is found in the substance of the crura cerebelli, which has been called *corpus ciliare*, or *corpus fimbriatum*; the bundle called *processus cerebelli ad medullam* would give rise to the cerebellum, after having been reinforced by the corpus fimbriatum, as the pedunculi cerebri are by the thalami optici, and the cineritious part of the corpora striata. But perhaps this analogy is not complete. The corpus fimbriatum is enveloped, and, as it were, immersed in the medullary matter, instead of giving a passage to it, and we do not observe that it supplies it with any filament.'

'Some person will perhaps add, after the example of Vicq-d'Azyr *, that the brute animals have no corpus fimbriatum, but the truth is, that it is only of a smaller size; and as their cerebellum is also much less, the fact would be more in favour than against the idea of our anatomists.'

This article, besides the decussation at the posterior part of the Medulla, which is of minor importance, considers two

* Acad. des. Sciences, 1783, P. 471.

of the most important subjects in the anatomy and physiology of the brain, viz. 1st, the use of the cineritious matter, and 2dly, the general course of the medullary matter. With regard to the first of these—the use of the cineritious matter, I have already shown that it is no matrix; and I have only now further to remark in confirmation of that, and in direct opposition to what is said respecting it in the present article, that the encrease of medullary matter never bears the slightest regularity of proportion to the quantities of cineritious matter which these gentlemen reckon its matrix, but which it certainly would do, were they any thing of the kind. . . . With regard to the 2d of these points—the general course of the medullary fibres, these gentlemen, after Vieussens, have only traced a portion of it, and that most inaccurately. It is true that THE PYRAMIDAL BODIES ARE CONTINUOUS WITH THE CRURA, CORPORA STRIATA, AND HEMISPHERES; BUT THE FILAMENTS NEITHER OF THE PYRAMIDAL BODIES, NOR OF THE CRURA, NOR OF THE CORPORA STRIATA ARE CONTINUOUS WITH THE THALAMI. Even the vertical section of Gall and Spurzheim proves the reverse of their own assertion, and illustrates the important fact which I am now stating. This section shows that the fibres of the corpora striata and of the thalami do not even lay in the same plane; for the striæ of the corpora striata pass obliquely forward, outward and upward from the crura, whereas the striæ of the thalami, far from being placed in that line, are situate posterior to the junction of the crura with the corpora striata, and commencing from the posterior part of the medullary mass of the hemisphere, run horizontally backward and inward toward the inner side of the nates, without descending as they pass backward, so that they appear not even parallel to the crura, but while they are nearly as low as the crura anteriorly, they are so much higher posteriorly that they form with them a considerable angle. THAT THE CRURA CEREBRI RECEIVE ANY FILAMENTS FROM THE PROCESSUS CEREBELLI AD TESTES IS EQUALLY AN ERROR—AN ERROR WHICH THESE GENTLEMEN MUST HAVE BEEN LED INTO BY THE CIRCUMSTANCE THAT THE FILAMENTS OF THE THALAMI OF WHICH I ALREADY DESCRIBED THE FIRST PART OF THE COURSE, AFTER PASSING BENEATH THE NATES AND TESTES, ACTUALLY DO TERMINATE IN THE PROCESSUS CEREBELLI AD TESTES, AND BY THAT MEANS IN THE MEDULLARY SUBSTANCE OF THE CEREBELLUM. Some difficulty attends the tracing of this course, on account of the delicacy of the filaments of the thalami and the straggling course in which some of them run. Having already considered two portions of the course of the medullary filaments their

remains only another about which they have similarly erred. As THE PROCESSUS CEREBELLI AD MEDULLAM ARE THE COMMENCEMENT OF THE POSTERIOR COLUMNS OF THE SPINAL MARROW, WHICH I HAVE ALREADY SHOWN MUST BE DESCENDING, THE CEREBELLUM CANNOT BE SAID TO ARISE FROM THEM, BUT THEY MUST BE SAID TO ARISE FROM THE CEREBELLUM...THUS THE GENERAL COURSE OF THE MEDULLARY FILAMENTS OF THE NERVOUS SYSTEM IS FROM THE NERVES OF SENSATION ARISING FROM THE SUPERFICIES OF THF BODY, TO THE ANTERIOR COLUMNS OF THE SPINAL MARROW, CORPORA PYRAMIDALIA AND CONTIGUOUS FASCICULI, CRURA CEREBRI, CORPORA STRIATA, AND HEMISPHERES; THEN FROM THE HEMISPHERES TO THE THALAMI, FILAMENTS BELOW THE TESTES, PROCESSUS CEREBELLI AD TESTES, AND MEDULLARY SUBSTANCE OF THE CEREBELLUM; LASTLY, FROM THE MEDULLARY SUBSTANCE OF THE CEREBELLUM TO THE PROCESSUS CEREBELLI AD MEDULLAM, POSTERIOR COLUMNS OF THE SPINAL MARROW, AND NERVES OF LOCOMOTION TERMINATING IN THE MUSCLES. Thus these German and French anatomists have completely erred with regard to the 4th article and the general course of the medullary fibres *.

'THE FIFTH, SIXTH AND SEVENTH ARTICLES should be 'examined together. These three form the most particular 'points of the doctrine of Drs Gall and Spurzheim; the 'seventh especially, relating to the possibility of unfolding the 'brain like a membrane, has made the most noise in the 'world; but, as is too commonly the case, scarcely any of 'those who have spoken of it have properly understood our 'authors; and those who have thought that they had found 'the fact in more ancient authors, had still less understood the 'circumstance itself, and the passages where they thought they 'saw it expressed.'

'The terms in which we have expressed the ideas of Drs 'Gall and Spurzheim, will make you already perceive that the 'question is not the unfolding the whole brain; they have ex-'pressly stated, at the meetings which we have had with them, 'that the parietes of the ventricles are such as they appear to 'be, and that they do not conceal any folds, except behind, 'towards the plaited margin, where their folds were, a long 'time ago, known to, and delineated by, Vicq-d'Azyr; only, 'our anatomists say that these thick sides, formed by the conver-'ging fibres, are the only bands which retain the folds of the 'external substance; this is attached there as the folds of a

* I shall further illustrate this course, in the following paper.

'plaiting, for example, are fixed to the stuff of a gown; if 'you remove the principal stuff, the folds will extend and form 'likewise a plain piece.'

'Your committee have examined, with all possible atten- 'tion, the hemispheres of the brain, in order to judge of the 'truth of so new a doctrine.'

'They think that they can, in fact, distinguish two or- 'ders of fibres in the medullary matter, but they find it neces- 'sary still to confine very much the idea which might be for- 'med of the unfolding, according to the expression which we 'have just stated.'

'We shall now explain, in succession, these two propo- 'sitions.'

'When we trace with the knife the fibres which come 'from the crura cerebri across the thalami optici and corpora 'striata, we see that they intersect, at angles more or less 'acute, those which go towards the middle line, and which 'form the corpus callosum and the fornix; it is even very 'easy to demonstrate their decussation in the inferior cornu of 'the lateral ventricles, and the diverging fibres which come 'from the corpora striata, appear very evidently to form a 'layer external to the converging fibres which compose the 'corpus callosum.'

'But, does this external layer follow all the duplicatures 'of the still more external layer of cineritious matter, which 'is called cortical,—and does it unfold itself as the latter 'might be unfolded, if it were alone, and freed from all the 'white matter which fills it?'

'One of these questions is evidently entirely independ- 'ent of the other, and to be decided entirely by the testi- 'mony of the senses.'

'Taking, in the first place, the circumstance in the strict 'acceptation in which it seemed to be announced, we had 'used every effort to enable us to adopt or reject it with cer- 'tainty; it would not be easy for us to make those who have 'not tried it understand how very great difficulties we have 'had to encounter. The medullary matter which fills the cir- 'cumvolutions of the brain is so soft that it sinks down by its 'own weight; however lightly one supports with the finger 'the convexity or the dorsum of one of these circumlocutions, 'its two sides separate horizontally, and each of them carries 'away a part of the medullary matter which filled up the in- 'terspace. The vessels are not ruptured, because they are 'for the most part placed in the direction in which the rupture 'takes place, and besides, because they pass through this me-

'dullary matter on account of its softness, as threads would 'pass through jelly or pomatum. It appeared to us, then, 'impossible to prove that there was an actual solution of con- 'tinuity; on the contrary, both with the naked eye and the 'magnifying glass, the two laminæ of the white matter ap- 'peared covered with small prominent points, with small fila- 'ments, which had quite the appearance of as many lacerations. 'We even tried to make the laceration begin so as to leave a 'thicker lamina of white matter on one side than the other, 'and it appeared to us that the separation was made as easily 'as in the middle.'

'The argument which the authors of the memoir draw 'from the example of *hydrocephalous patients* did not appear to 'us much more conclusive. An accumulation of fluid in the 'ventricles of the brain may slowly distend the parietes, ef- 'face the projection of the circumvolutions, and render thin 'the medullary matter which surrounds them, without the 'latter being necessarily unfolded; the dropsy of the kidney 'distends and lessens the substance of that organ to such a 'degree, as to make it resemble a membrane, without any 'one being tempted to suppose that it was unfolded. The 'phenomena of hydrocephalous patients who preserve their 'intellectual faculties for a long time, proves nothing further; 'for, as we do not know with what part of the brain, 'nor with what circumstance of its organization these faculties 'are connected, we can draw no conclusion from it relative to 'the essential structure of the brain.'

'Farther, we have also examined hydrocephalous pa- 'tients; the parietes of the ventricles, though extended, had 'the same appearance as usual, and the circumvolutions, al- 'though thinned and partly effaced, nevertheless preserved 'their internal solidity.'

'Such were the ideas excited in us by the first memoir 'of Drs Gall and Spurzheim, compared with the objects them- 'selves; but these anatomists have since transmitted to us an 'additional note, in which they point out new modes of as- 'certaining the facts, and in which they explain their mode 'of viewing them with more precision.'

'M. Spurzheim has repeated, in our presence, these new 'experiments; vertical slices of the circumvolutions, mace- 'rated in nitric acid, diluted with rectified alcohol, became 'hard, and were divided more easily at the middle line; the 'same took place when they were boiled for twelve or fifteen 'minutes in oil; when one blows on such a slice, or directs a 'small stream of water on it with a syringe, the separation

'may be made very easily in the middle, and scarcely at all 'at the sides. In the latter case, especially, the two surfaces 'which are separated remain smooth, and the vessels passing 'through them untouched, without shewing any traces of 'fibres which might have gone from the one side to the o-'ther.'

'These facts are accurate; but perhaps they only prove 'that there is less cohesion in the middle of a circumvolution, 'than in the rest of its capacity, and not that it is formed of 'two laminæ simply applied, and not adhering.'

'In other words, it may be admitted, in our opinion, 'that the white or intermediate portion of each circumvolu-'tion, is formed of two parts, which adhere to each other 'more slightly than the particles of each among themselves, 'or the union of them may be compared, for example, to that 'of the two laminæ of the dura mater, but not, as was sup-'posed, to that of the two sides of an intestine compressed, 'except, however, that the medium of union is not cellular 'matter, as in the dura mater; but the medullary substance 'itself a little softened.'

'Besides, as this is a point of fact, admitting an appeal 'to the senses, we do not pretend to give to our opinion more 'authority than it ought to have; this question cannot be long 'of being examined by every anatomist, and will find as many 'judges as observers; it cannot fail, then, of being soon finally 'fixed.'

'It is a great deal more difficult to demonstrate these or-'ders of fibres in the cerebellum, than in the brain; and it is 'by analogy, rather than by actual knowledge, that Drs Gall 'and Spurzheim admit their existence there.'

'With regard to what they say of the commissures of the 'brain and cerebellum, their ideas are not new, or different 'from what has been already advanced by a very great num-'ber of anatomists; we may also add, that there is nothing 'in them which is not very probable.'

In commenting on these three articles, I need not refer to those parts of them, the errors of which have been already pointed out in the previous notes; nor to that which is said respecting the commissures, since it is neither original nor questioned by any one. On the last of these subjects, I may, however, merely mention, that there is a much more important commissure of the cerebellum than the layers of the pons varolii mentioned by these anatomists, namely, the medullary mass which forms the roof of the fourth ventricle. The important subjects of these articles are the orders of the medullary fibres and

the plaitings which these gentlemen say exist in that order which they term external. With regard to that which they term plaitings, they by no means appear to me to be such. I have repeated the experiments referred to with great care, and have found that this appearance of folds, as they are termed, does not arise from two laminæ simply applied and not adhering—in short that they are not folds, but that the appearance arises from the meeting of three orders of fibres in each convolution, viz. an order ascending from the corpora striata, an order receding by the thalami, and an order crossing chiefly by the great commissure. It is actually the separation of the fasciculi of these which run to or from each convolution, intermixing in every direction, but being least intermixed in the centre, that produces the effects by which these gentlemen were misled. As to the orders of fibres, 'your committee *think* that '*they* can, in fact, distinguish two :'—if 'your committee' had possessed either fingers or eyes, it might have distinguished four with the utmost facility. For, besides the three which I have already mentioned, there is actually at least a fourth great order of medullary fibres, which, in the first part of their course, run directly from before backward, and which consist, not merely of the detached fornix, but of the thick sides of the lateral ventricles. The course of the filaments of the fornix is obvious to the eye during a great part of it, and dissection afterward shows, that, expanding into a broad medullary sheet, these filaments run from behind forward and outward under the corpora striata, which they join at their termination in the hemispheres. The filaments of the sides of the lateral ventricles I have not yet traced so far as those of the fornix, but their remarkable distinctness from the medullary matter external to them and their longitudinal course, will be apparent to any one who chuses to make a horizontal section through them, and observe them with the slightest attention. They may even be entirely elevated without injury to the medullary matter of the hemispheres immediately external to them. Thus these German and French anatomists have erred respecting the important subjects of the 5th, 6th and 7th articles of the Memoir and Report.

'We find the same probability in the commissures which 'THE EIGHTH ARTICLE attributes to each pair of nerves. It 'amounts almost to certainty in all the spinal nerves, whose 'commissures are the transverse filaments of the spinal mar-'row. We may suppose, that the small band which unites the 'two facial and the two auditory nerves in animals, is conceal-'ed in man by the pons varolii ; the two pathetics touch each 'other on the valvula vieussenii ; the two optic nerves, as every

'one knows, appear almost to be intermingled together anteriorly to the pituitary gland; besides, their roots must unite at the same time as the nates and testes on the aqueduct of Sylvius. There would then only remain the abductors, motores oculorum, and olfactory nerves, which would not have visible commissures. The anterior commissure of the brain, also, is evidently united to the olfactory nerves in brute animals.'

'This generality of the commissures seems to assist in explaining the unity of action of the double organs.'

That the transverse filaments of the spinal marrow are the commissures of the spinal nerves, is doubtless very *probable*, and that all the other nerves *may* also have commissures, is *probable* also.

'THE NINTH ARTICLE is one of those which have been the most contested by the anatomists of Germany, and which are in fact the most susceptible of being so. It attempts to establish, in the first place, the generality of tubercles of cineritious matter for each pair of nerves; secondly, the analogy of these tubercles with those called ganglions; lastly, the analogy of these two kinds of organs, both with the cortical matter of the brain, and with the mucous expansions of the organs of the senses.'

'That each pair of nerves belongs originally to some tubercle, or, at least, to some portion of cineritious matter of some form, may be very readily maintained, with regard to the spinal nerves, and as far up as the par vagum, since cineritious matter extends the whole length of the spinal marrow, although it is not possible to follow the roots of the nerves so far; it is even certain, with respect to the auditory nerve which arises from the small cineritious band in man, or from the much more marked tubercle which supplies its place in the greater number of brute animals; and with regard to the optic nerve, which has at least two of these tubercles, the natis and the *corpus geniculatum externum*, and perhaps also two others, the testis and *corpus geniculatum internum*; the olfactory has at least one at the place where it rests upon the cribriform lamella of the ethmoid bone; but the eye can perceive nothing of a similar appearance in the other cerebral nerves in man, in the mammalia, and in birds, although the par trigeminum has a tubercle in fishes.'

'The probability of the analogy of the spinal ganglia, and of those dispersed in the nervous system of organic life, with the portions of cineritious matter ascribed to the pri-

'mitive origins of each pair of nerves, is liable to difficulties 'of a very different nature.'

'Anatomists, among whom it is sufficient to mention 'Winslow, have undoubtedly, for a very long time, regarded 'the ganglia as little brains, as sources of nervous action, in-'dependent of the great brain; others, such as Willis and 'Vieussens, have at least considered them as reservoirs of the 'animal spirits; or, like Lancisi, as organs which may be 'compared to a heart, and adapted to communicate a more 'rapid motion to these spirits.'

'Scarpa, of late, as well as Meckel and Zinn, in former 'times, was only willing to consider them as subdivisions, re-'unions, and recompositions of nerves, enveloped and strength-'ened by cellular substance, bathed in a reddish fluid, and 'sometimes intermixed with fat.'

'The existence of this cellular membrane, and the fat 'which is sometimes deposited in them, have been acknow-'ledged by the most distinguished anatomists of the present 'times. They are very distinctive characters, which do not 'permit the substance of the ganglia to be confounded with 'the cineritious matter of the brain. However, this substance 'has also some peculiarities, which ought not to allow it to 'be confounded with ordinary cellular membrane; but the 'nature of these is certainly unknown.'

'The idea, that the ganglia dispersed between the dif-'ferent branches of the sympathetic nerves have the effect of 'protecting the filaments of the nerves, reserved for the or-'ganic life, ought to occur, and, in fact, did early occur to 'physiologists; but why have not the spinal ganglia, which 'resemble the others so much, the same effect? Of this point 'we are still ignorant; all is here involved in darkness and 'obscurity.'

'It is of no service to science to offer any new opinion, 'or to revive any old opinion, without having more proofs in 'support of the one than of the other. It is better openly to 'confess our ignorance, and to separate distinctly the things 'which are known from those which are not. The human 'mind, it is said, supports doubts with difficulty; but it is 'precisely on that account, that the learning to bear with them 'ought to be one of the principal studies of men of real know-'ledge. The works of some modern physiologists have led 'to this short digression.'

'The analogy of the cineritious cortical part of the brain 'and cerebellum, with the tubercles in its internal substance, 'such as the corpora striata, the thalami optici, the nates, &c.

'is much better established than that of the ganglia. Every 'one recognizes there nearly identity of substance; sameness 'of function would there also be readily admitted. But 'what can we say of the comparison between it and the mu-'cous body which lines the skin, and all its internal prolon-'gations? Here there can only be, with respect to structure, 'texture, in short, physical nature, a resemblance purely hy-'pothetical. In absence of actual observation, it would re-'quire, then, to justify this comparison, some resemblance in 'the functions, in the uses, in the mode of existence during 'life; but where shall we find these?'

'We confess, also, that we do not comprehend the rela-'tion between these masses of cineritious matter, where the 'medullary bundles are strengthened in passing through them, 'and the rings which surround the base of the young branches 'of a tree: in trees, the branches go off in succession, one 'from the other; but, in the nervous system, the whole is 'formed at once. It is impossible to find here any thing but 'an accidental resemblance.'

The ascription of tubercles of cineritious matter to each pair of nerves is quite unsupported, except by the hypothesis that such matrices, as I have shown the absurdity of, are necessary to them. Wherever the cineritious matter exists, it serves a very different purpose, as will appear in the following paper. As to an analogy between the cineritious matter and the ganglia, it has no existence, and can only be insisted on by those who choose to abandon anatomical facts for the most hypothetical species of physiology. The German anatomists have erred on both of these points, and the French appear to err with them respecting the first.

'Such, Gentlemen, is the report which we have thought 'it our duty to make to you.'

'We have repeated all the observations of Drs Gall and 'Spurzheim; we have even submitted to a new examination, 'part of those which were made by older authors, but con-'nected with theirs; in fine, we have pointed out the degree 'of justice which we have found in the old as well as in the 'new remarks.'

'We therefore think that we have fulfilled, as far as lay 'in our power, the commission with which the class has ho-'noured us.'

'You will now perceive, that we are far from adopting 'all the views and all the observations related in the memoir 'of these anatomists, but that we are also far from rejecting 'them entirely.'

'Finally, it appears to us, 1st, That Drs Gall and Spurzheim have the merit, not of having discovered, but of having recalled to the attention of physiologists, the continuity of the fibres which extend from the medulla oblongata into the hemispheres, and into the cerebellum, which Vieussens first detailed, and the decussation of the filaments of the pyramidal eminences described by Mistichelli, by Francis Petit, and by Santorini, but with regard to which some doubt had been entertained.'

'2d, That they are the first who have distinguished the two orders of fibres, of which the medullary matter of the hemispheres appears to be composed; the one of which diverges from the pedunculi, while the other converges towards the commissures.'

'3d, That, by uniting their observations with those of their predecessors, they have made it very probable, that the nerves called cerebral ascend from the medulla oblongata, and do not descend from the brain; and that, in general, they have very much weakened, not to say overturned, the system which makes all the nerves come originally from the brain.'

'But it also appears to us, 1st, That they have generalized rather in an inconsiderate manner, the resemblance of structure, and of functions in the various cineritious, or ash-coloured masses, which are met with in the different parts of the nervous system.'

'2d, That the idea which they entertain of a solution of continuity in the middle of the medullary matter of each circumvolution, which would permit of its being unfolded like a pipe or a purse, requires to be expressed in more definite terms than they have hitherto done, so as to indicate, that there is no complete proof of an absolute solution of continuity, but only of a more feeble cohesion.'

'We ought however to remark, that these two articles do not affect their general result, with regard to the kind of separation and of reserve into which they place the brain; and we ought, at the same time, to allow physiologists and pathologists to judge how far this kind of separation or laying aside, which anatomy seems to point out, is justified by facts, and how far it may favour the explanation of the numerous and astonishing phenomena of organic and animal life, and especially of those in which these seem sometimes dependant upon, sometimes distinct from, each other.'

'The entering into all these questions would engage us in endless discussions, and foreign to our commission.'

'Nor shall we propose to the class to decide upon the 'conclusion drawn by our anatomists, that there is no circum- 'scribed place in the brain to which all the sensations go, and 'from which all the voluntary motions issue, but that both of 'these functions may be exercised in a greater or smaller ex- 'tent of the nervous system.'

'This opinion is undoubtedly that of Haller, Bonetus, 'and of the greater number of physiologists. There can be 'no doubt that it is from having confounded the metaphysical 'simplicity of the soul with the physical simplicity attributed 'to atoms, that the desire has originated of placing the seat 'of the soul in an atom: but the connection of the soul and 'body being necessarily incomprehensible to our minds, the 'more or less limited sphere which it is wished to give to the 'sensorium would not, in the smallest degree, assist our con- 'ception of it.'

'But all these subjects are also too foreign to the busi- 'ness of the class; they are too slightly connected with phy- 'sical facts; they lead to discussions too vague to form a pro- 'per object of attention for such a body as ours.'

'We think ourselves, however, obliged to finish our in- 'vestigation, by remarking, that, if we were even to adopt 'the greater number of the ideas of Drs Gall and Spurzheim, 'we should still be far from knowing the relations, the uses, 'and the connexions, of all the parts of the brain.'

Upon these summary observations, I have only, in a similar summary way, to observe, that Drs Gall and Spurzheim have thus, as already shown, obviously erred, 1st, with regard to the general course of the medullary matter; 2dly, with regard to the particular origin of every nerve; and, 3dly, in every attempt at physiological reasoning.

'So long as we have not even a well-grounded conjec- 'ture with regard to the functions of the pituitary gland, of 'the infundibulum, of the mammillary eminences, of the cords 'passing from these eminences into the substance of the tha- 'lami, of the pineal gland, and of its pedunculi, we must 'apprehend, that any system whatever, with regard to the 'functions of the brain, is very incomplete, since it will not 'embrace these parts so numerous, so considerable, and so in- 'timately connected with the whole of this important organ.'

'This is almost finishing with as much doubt, and as 'much uncertainty, as we began; but one can only require, 'on every subject, the degree of probability of which it ad- 'mits; and the natural philosopher always performs his task

'very well, when he neither exaggerates nor diminishes this 'probability, and when he fixes its degree with precision.'

This I shall endeavour to do, with regard to all these points, and several others of still greater importance, in the following paper.

'It is of importance to repeat once more, if it were only 'for the information of the public, that the anatomical ques- 'tions with which we have been engaged in this report, have 'no immediate and necessary connection with the physiolo- 'gical doctrine taught by Dr Gall, with regard to the func- 'tions and the influence of the relative size of the different 'parts of the brain, and that all that we have examined with 'respect to the structure of the encephalon might be equally 'true or false, without any conclusion being drawn for or 'against this doctrine, which can only be determined by quite 'different means.'

'Given at the Institute, the 15th April 1808.

'(Signed) Tenon, Portal, Sabatier, Pinel, Cuvier.'

'The class approves of this report, and adopts its con- 'clusions.'

'Conform to the Extract,

'(Signed) CUVIER, perpetual Secretary.'

Never was a more unlaboured, careless, superficial and thoughtless report presented to, and approved and adopted by, any national body of scientific men. When we consider this, the slight merit, which arose from the *very few original facts* which have been observed, and from the ponderous works which have been *compiled* by Messieurs Tenon, Portal, Sabatier, Pinel and Cuvier, almost disappears, and threatens the Institute, already degraded by obsequiousness to a tyrant, with contempt in the eyes of Europe, and speedy and deserved extinction.

PATENT OFFICE LIBRARY.

NEW ANATOMY AND PHYSIOLOGY OF THE BRAIN IN PARTICULAR, AND OF THE NERVOUS SYSTEM IN GENERAL.

BY THE EDITOR.

I have entitled this paper, New Anatomy and Physiology of the Brain, &c., because, while the whole of the physiology which it delivers is original, all the leading facts of anatomy upon which that physiology is founded, such as the general course of the medullary matter; the double origins, as they are termed, of the nerves, &c. are not less so. The object of this paper consequently prevents my entering into such details as are known to every one, and limits me to the notice of such facts as are either entirely original, or, from being placed in a new point of view, admit of original conclusions. The paper is, therefore, a brief one, though, from the magnitude of the anatomical facts and physiological reasonings which it delivers, it presents a connected system both of the anatomy and physiology of the nervous system in general, and of the brain in particular.

ANATOMY.

Although the face and cerebellum are, in different animals, very differently placed with regard to the cerebrum, yet there is a peculiar relation between the situation of one of these and that of the other, with regard to it. In other words, although the face is sometimes in one situation and sometimes in another with relation to the cerebrum, yet to each given variation of its situation with regard to that body, there is a corresponding and uniformly accompanying variation in the situation of the cerebellum. Thus, in man, as the face is placed below the anterior part of the cerebrum, so the cerebellum is placed below its posterior part, and precisely as in the inferior animals, the face advances, precisely so does the cerebellum recede, till, in those animals in which the face is placed exactly before it, the cerebellum is placed exactly behind it.

Moreover, both the face and cerebellum are in general separated from the cerebrum either by membranes or by bony plates. Thus, an analogy always exists with regard to their situation.

As both of these masses are, generally speaking, composed of two substances—a medullary and a cineritious, I shall especially treat of the arrangement of the first, in the following paragraphs; and respecting the last, I have only to observe, that it is uniformly placed so as to separate or support the portions of the former.

The medullary matter may be traced as continued from the portions of many nerves which join the two anterior columns of the spinal marrow *, upward through these columns to the inferior fasciculi of the medulla oblongata, forward through the crura cerebri, and forward, outward and upward through the corpora striata, and the hemispheres of the cerebrum. From the hemispheres, it passes posteriorly, backward, inward and downward through the thalami, backward through the striæ inferior to the nates and testes, and backward and upward through the processus cerebelli ad testes, or the anterior peduncles of the cerebellum, to the substance of the cerebellum itself †. Lastly, from the cerebellum, it passes down-

* When the two anterior columns of the spinal marrow are separated, innumerable commissures appear, and these are the only points at which these columns anteriorly join. Immediately behind these columns, descends in many animals the continuation of the 4th ventricle *. and behind that continuation run the two posterior columns of the spinal marrow which are divided by a raphe posteriorly. As, however, each of the anterior columns greatly exceeds in size the posterior, they embrace them laterally, and also appear posteriorly, so that, from this circumstance and the existence of the raphe, there is even the appearance of four columns externally; each of the lateral ones having a concavity in order to embrace the posterior ones, and that concavity being also on each side partially occupied by cineritious matter. A transverse section best shows the absolute existence of these columns.

† In making a section of the thalamus, the divided striæ appear most numerous toward its upper and outer, and much more scattered toward its inner side; and, in dividing still downward, a section of the crura cerebri appears inferiorly. By making a second section about the middie of the thalamus, its exterior superior filaments appear to unite into a denser semicircular form, the convexity of which is still toward its outer and upper side, and, at the lower part of which the crus cerebri appears still more distinct. By making a third section, this arrangement becomes still more evident, but, at the same time, more contracted, and passes more toward the inner and under side of the Natis and Testis, gradually approaching the processus cerebelli ad testes or the anterior peduncle of the cerebellum. A horizontal incision also, if made immediately below the level of this semicircular tract, shows that the striæ of the thalami terminate in a longitudinal fasciculus, which passing inferiorly and interiorly to the natis and testis, terminates in this peduncle. Thus are the Cerebrum and Cerebellum connected by the medullary substance.

* See Mr Sewell's paper in this Vol. I had observed the same fact before I saw Mr S's paper; but as that gentleman has first published it, the discovery is doubtless his, and it gives me pleasure to quote his observation.

ward by the corpora restiformia, superior fasciculi of the medulla, processus cerebelli ad medullam or posterior peduncles of the cerebellum, to the posterior columns of the spinal marrow, and the remaining portions of the numerous nerves which join it. Thus the medullary fibres form a most remarkable circle of which this is the direct course *.

From this course, there are three remarkable deviations. The first of these, is that through the peduncles of the pineal gland which can only be impressed by the cerebral terminations of the 3d encephalic pair of nerves, or by the undulations of the fluid of the 3d ventricle, and which are continued forward and downward through the thalami to the corpora albicantia, in the neighbourhood of the pituitary gland, from which they ascend as crura of the fornix, expand backward and outward into that body, pass downward and forward in broad medullary sheets into the inferior cornua of the lateral ventricles, then outward through the cineritious matter of the cerebrum beneath the corpora striata, which they join inferiorly, where these bodies terminate in the hemispheres. The second deviation, from the direct course above described, is by means of the commissures, of which there are three in the cerebrum—the great or superior commissure called corpus callosum, which, on each side, proceeds from the junction of what I should denominate the advancing and returning fibres in the hemispheres; the anterior commissure, which is that of the corpora striata or ascending fasciculi; and the posterior commissure, which is that of the thalami or returning fasciculi †; and also one in the cerebellum formed by the junction of the medullary substance over the 4th ventricle, to which the posterior edge of the valvula Vieussenii is fixed. The third deviation from the direct course is by means of two remarkable bands of medullary fibres which run along the outer sides of the lateral ventricles, commencing seemingly by minute filaments given off posteriorly by the inferior edge of the outer end of the superior commissure....This is a connected view of the whole of the medullary matter of the cerebrum, cerebellum, spinal marrow, &c.

There are, however, some peculiar involutions of struc-

* In many sections of the cerebrum and cerebellum, these directions of the medullary filaments are very apparent. In making a vertical section of the cerebellum, its ascending and descending filaments become frequently very evident; they seem to differ, by a slight shading, in colour, owing doubtless to the different arrangement of their particles; and appear to bend slightly around each other.

† That which is called commissura mollis is really no commissure, as it is not even formed of medullary matter; and that which is called the inferior, is equally ill entitled to the name, as its fibres are longitudinal and not transverse: it is, in fact, nothing more than the upper surface of the crura which it would be foolish to denominate a commissure.

ture about the medulla oblongata. The columns of the spinal marrow are there formed into six or seven longitudinal fasciculi, and the cerebellum sends down over them three transverse medullary bands, of which the pons Varolii is one. Its internal structure is also somewhat complicated *.

Of the nerves connected with these masses, I have already mentioned the spinal. Like these, all the encephalic nerves have two portions—a cerebral and a cerebellic, except the 1st 2d and 7th, which have only a cerebral portion, and the 6th, which has only a cerebellic one †.

* Viewing the Medulla Oblongata inferiorly, there appear upon it a number of longitudinal fasciculi. Of these, the two internal or corpora pyramidalia pass superficially upward, till they arrive at the Pons Varolii, over several fibres of which, some of their fibres pass; the narrow transverse band immediately below the Pons being also covered by them, and the broad transverse Band below that, not advancing so far down as their sides. External to these, are other two, which also advance to the Pons, covering, in their ascent, another portion of the band below the Pons, and the broader Band, inferior to that, advancing precisely to their sides. These last are placed between the Corpora Pyramidalia and the next or Corpora Olivaria. The Corpora Olivaria are external to the last, do not extend superficially so far downward as they, and, at their lower part, are embraced by the broad transverse band, from which, projecting considerably, they ascend to the narrow band below the Pons, and there disappear. External still to these, is another Fasciculus of similar length, still more entirely covered by the broad transverse band and similarly advancing to the narrow band below the Pons. Posterior to this last, is yet another entirely covered by the transverse band and forming some part of the sides of the fourth Ventricle. This last bends inward and downward so as to form the posterior columns of the Spinal Marrow, and, in this, seems to be joined by a Fasciculus running externally to its inferior part. Within this, still another fasciculus appears. In future, these may be denominated the 1st, 2d, 3d, 4th, 5th and 6th Fasciculi of the Medulla Oblongata, to which indeed may be added a 7th, appearing on each side the bottom of the 4th Ventricle.

The Pons Varollii, descending on each side from the cerebellum, is the first of the transverse bands of the medulla oblongata. The second, which is smaller, first appears immediately under the external origin of the 8th pair, and descends to meet its fellow, where it is covered by the corpora pyramidalia; being, throughout, in contact with the pons. The third or broadest and thinnest sheet of medullary fibres, is first seen immediately below the cineritious appendage of the external origin of the 8th pair, and appears to emerge from under it. It passes in a curved direction downward and backward, embracing, at this part, the medulla oblongata, just as the pons does above, and terminating by the sides of the 2d longitudinal fasciculi. This band does not run in contact with the 2d. It forms the cerebellic origins of the 9th and 10th pairs.

With regard to the internal structure of the medulla oblongata, a tendency to the formation of the 4 great columns of which the Medulla Spinalis consists, may be seen in it, but, the nearer to the Cerebellum the more do the 2 posterior Columns separate, and their envelopement in the inferior transverse medullary band gives an irregularity to their appearance. Besides this, the Medulla Oblongata may be considered as a case of pure Medullary matter constructed as I have described, but enveloping Medullary fibres somewhat intermixed with cineritious matter and disposed chiefly in radii converging toward the bottom of the 4th ventricle. A longitudinal perpendicular section shows, that the part of the Case forming the Corpora Pyramidalia anteriorly is a production of the anterior columns seen ascending through the bottom of the 4th Ventricle, but which separates from them at the lower part of the Medulla and runs anterior to the converging Striæ.

† See a more particular account of these portions in the notes on the preceding Memoir and Report.

Thus I have given such a rapid sketch of the anatomy of the brain, as, to those who already know something of it, may exhibit the newly discovered facts, and lay the basis of the subsequent,

PHYSIOLOGY.

From the peculiar opposition which subsists between the situation of the face and cerebellum, we are entitled to expect a similar opposition in their functions. As the face, therefore, occupied by the chief organs of sense, is the seat of sensation, so we might expect the cerebellum to be the organ of volition. This supposition receives additional force from the consideration that, as the organs of sense and the cerebellum are the first and the last portions of the nervous system, so sensation and volition are the first and the last of its functions. But this supposition is completely confirmed, when we recollect, that the degrees or voluntary power always bear a close analogy to the various magnitudes of the cerebellum. In fishes, for instance, which possess amazing locomotive power, the cerebellum is often larger than the hemispheres !*

Of the two substances which compose the cerebrum and cerebellum, the cineritious evidently serves the purpose of supporting and separating the portions of the medullary, so as to prevent the medullary actions of one portion from affecting, in any way, those of another. With this view, it is often placed in situations where it can serve this purpose alone ; as in the case of the small portion of cineritious matter attached to the interior inferior side of the peduncle of the pineal gland, seemingly for the purpose of protecting that body from the impulse of the fluid ascending through the foramen commune posterius, or as in that of the portion covering the external and somewhat superior part of the crus of the fornix, which being superior anterior to the foramen Monroianum, protects the fornix from the impulsion of the fluid of the third ventricle issuing through that foramen to the lateral ones. In the spinal marrow, this matter prevents the actions of the anterior from affecting those of the posterior columns, and vice versa. In the cerebrum, it similarly separates and supports the convolutions of the medullary matter, &c.

* The function of *Sensation* has been so amply considered in the paper on the Intellectual Functions, in the 2d vol. of the Archives, that it would be useless to reconsider it here.

The course of the actions in the other matter—the medullary, is precisely the same with that of the structure itself, as I have described it. For, it is evident, that two species of action take place through this structure—one obviously advancing from the organs of sense toward the sensorium commune, and another returning from the sensorium commune to actuate the muscles and produce locomotion. Now, it does not accord with the distinctness of natural operations to suppose, that these motions in opposite directions take place through one and the same series of particles. It is far more accordant with that distinctness, to suppose, that they take place through different series. And this becomes confirmed when we observe that circuitous course of the medullary fibres of the brain which in this paper, I have described, the double columns of the spinal marrow, which have for some time been known, but have never hitherto been traced in connexion with that general course, and the double origins, as they are termed, even of the encephalic nerves, which I have here pointed out. Nature, thus, presents to us the double means by which this double operation is effected.

But it may be questioned by which nerves, columns and cerebral masses, the action ascends to the brain, and by which it descends to the muscles. Fortunately, here nature also directs us. Several nerves of mere sensation join the anterior masses; hence, they must be the ascending: one nerve of mere locomotion proceeds from the posterior masses; hence, they must be the descending—for sensation, as already said, must ascend to, and volition must descend from the sensorium commune.

Thus, then it is proved to us, that medullary action commences in the organs of sense; passes, in a general manner, to the spinal marrow, by the anterior fasciculi of the spinal nerves, which are, therefore, nerves of sensation, and the connexions of which with the spinal marrow or brain must be termed their spinal or cerebral *terminations*; ascends through the anterior columns of the spinal marrow which are, therefore, its ascending columns; passes forward through the inferior fasciculi of the medulla oblongata, and then through the crura cerebri; extends forward, outward and upward through the corpora striata; and reaches the hemispheres of the cerebrum itself. This precisely is the course of its ascent to the sensorium commune.

From the posterior part of the medulla of the hemispheres, it returns by the thalami, passing backward, inward and downward; flows backward in the fasciculi under the nates and testes; backward and upward through the processus cerebelli ad

testes or anterior peduncles of the cerebellum; and thns reaches the medulla of the cerebellum itself.

From the cerebellum, it descends through the posterior columns of the spinal marrow, which are, therefore, its descending columns; and expands through the posterior fasciculi of all the nerves, which are therefore the nerves of volition, and the connexions of which with the spinal marrow or brain must be termed their spinal or cerebellic *origins*. This precisely is the course of its descent from the sensorium commune toward the muscular system.

Now, from this course, it is evident, that impressions acting on the organs of sense, and there producing sensations, will reach by this route the sensorium commune and there constitute PERCEPTION, or, in other words, will have their influence diffused from this central point and rendered universally cognizable to the system; for all the actions which take place in this system must be cognizable to it, end even the action of other systems can only be cognizable by means of this one *. By this means, then, perception may be understood; and volition would similarly appear to consist in the transmission of the impulse from the cerebellum, the new modification which, from its structure, that impulse must undergo, and its rapid descent through thc posterior columns to the muscular organs. All this, however, would not, by any means, explain the more complex operations of mind—understanding, reasoning, judgement.

Now UNDERSTANDING differs from perception in this, that while the latter considers only simple and distinct sensations, the former considers two or more of these in connexion, and determines their relations. But, in order to consider two or more perceptions in connexion, and determine their relations, it is necessary, and only necessary, that these perceptions should at one time exist in the sensorium; for, if they do exist, both they and their relations must, from the nature of that system, be cognizable to and, therefore, considered by it. In order, therefore, to be compared, and have their relations determined, it is only necessary that a preceding and a succeeding perception should, at one time, exist in the sensorium.

But, to effect this union of preceding and succeeding action, it is obvious that the preceding should be retarded or the succeeding accelerated, or that each action should be propagated through two different media, which, by the solidity of the one and the liquidity of the other, or by their shorter or longer

* See an illustration of this in the paper on the Intellectual Functions.

course, may convey these motions in different times, so that a portion of the first, passing by the longest route, may be blended with a portion of the second passing by the shortest, and so on.

This—precisely this, is effected in the cerebrum. The direct course of the medullary fibres, on the one hand, and the fluid of the ventricles, with the circuitous course of the fornix, on the other, present the two media through both of which all medullary action must be propagated, and in each of which they must pass in different times, so that a preceding by the longest and a succeeding by the shortest path must inevitably be blended in the sensorium.

For, the two anterior or ascending columns of the spinal marrow, expanding into several fasciculi in the medulla oblongata, form almost the whole of the parietes of the 4th ventricle, and the crura cerebri form all the bottom of the 3d. Their ascending impulses will, therefore, be communicated to the liquid of these ventricles, and will be the more powerfully communicated, that both the inferior or ascending fasciculi of the medulla at the bottom of the 4th, and the crura at the bottom of the 3d ventricle send up, from every point, converging radii which seem destined only to increase the impulsion. The liquid will, thus, undulate through the foramina opening into the lateral ventricles; flow backward through these ventricles, and transmit the impulsion to the delicate medullary fibres of the fornix which, exposed to its influence, expand widely to receive it. By the termination of the fornix, the action will be continued forward, outward and upward to the points already described, where inferiorly the corpora striata join the hemispheres. Thus, after a long course, a previous action will only have reached the hemispheres at the time when a succeeding one by the direct course, through the crura cerebri and corpora striata, has reached the same point; and, thus, in consequence of the difference of the times in which by different media they are conveyed, do two distinct perceptions at the same instant exist in the sensorium commune, and have their relations compared and determined. This, then, is the process which is denominated understanding or apprehension, and the results of which, losing the name of perceptions, and being, as we have seen much more complex, are termed IDEAS *.

* In the production of these effects, the use of some parts is of less essential importance, and has not been mentioned in the text. The current of liquid in the 3d ventricle, divided by that which is improperly termed the commissura mollis, is partly impelled upward through the foramen commune posterius, and, by a rather longer course, partly downward through the infundibulum. Passing upward through the foramen commune posterius, it must be partly caught by the posterior

Now as understanding requires the existence of two perceptions, so the next process—REASONING or comparing requires the existence of two ideas. Reasoning, therefore, demands a repetition of the process of understanding; for, from the explication already given of the encephalic mechanism, it is evident, that two of these processes cannot at once exist. The performance, therefore, of one process of understanding, its discharge, and the instantaneous reception of another, in which, from their rapidity of succession and the permanence of their effects, the relations of these processes become obvious or are compared, constitutes the process of reasoning.

Thus, sensation, when transmitted to the sensorium commune, and having its influence diffused over the system, constitutes *perception;* when two of these perceptions, in consequence of the difference of the times in which their different media convey them, exist at once in the sensorium and have their relations determined, the process is termed *understanding* and its results are ideas; and when two of the processes of understanding rapidly succeed each other and have their relations determined, the operation is termed *reasoning*. These processes, then, differ from each other in their different complexity: the second forms, as it were, a duplicature of the first, and the third forms a duplicature of the second. Thus the mechanism of these three processes is understood.

Pleasure and pain, and desire and aversion, or, in other words, EMOTIONS and PASSIONS can scarcely occur after the

commissure and impelled against the anterior cavity of the pineal gland. By this means, the gland will be thrust backward, and its peduncles will be stretched in the same direction. Now, as the compression of a nerve deprives it of action, so will this extension, and hence these peduncles which descend through the thalami, and, in the corpora albicantia, join the origins of the fornix, will be deprived of all irregular action, and very beautifully prepared for a new and regular impulsion by the very same fluid, in the following way. Part of the liquid, which thus ascended in the foramen commune posterius, will, as already stated, be carried forward and downward by the same impulsion to the infundibulum. In this tube, it must descend and impinge upon the pituitary, just, as a moment before, it did upon the pineal gland. Now, the pituitary gland projects upward, by two small medullary masses, laterally and somewhat posteriorly to the infundibulum, and, upon these masses, rest the corpora albicantia. Hence, the moment the impulsion reaches the pituitary gland, resisted by the osseous substance on which it rests, it will react, through these medullary masses, upon the corpora albicantia, and the impulsion will be propagated along the crura of the fornix, nearly at the very moment when the delicate medullary fibres of its sides are impressed by the vibration of the liquid of the lateral ventricles. Thus by means of the liquid of the 3d ventricle, acting retrogradely on the pineal gland, on its peduncles and on the origins of the fornix, all irregular action to which, in that central situation, these parts are much exposed, is, in one moment, destroyed, and, in another, by the very same impulsion, acting directly on the pituitary gland, on the corpora albicantia and on the fornix, new and regular action is produced. This appears to me to be the office to which these parts are adapted; but it is merely conjectural, and I have, therefore, not introduced it in the text.

second part of this process; for they are less frequently the result of pure understanding than of reasoning and the more complex operations. I may here, however, observe, that their nature is easily explicable. Whatever actions in these parts pass not with ease in the accustomed channel will form a strong contrast to those which glide with facility—the one will be discordant, the other congenial to the habits of the parts—pain will be applied to the one, pleasure to the other; and, when these are viewed in connexion with an idea, they will constitute a pleasurable or painful emotion. When these actions are in excess, they will evidently be propagated, in the course I have described, to the organ of volition; they will receive the name of passion; and a voluntary act will be induced, which is termed the result of passion: if pleasurable emotion precede this act, it will constitute desire; if painful, aversion.

By means of the commissures, a correspondence of action will evidently be maintained in the two sides of the cerebrum and cerebellum, and the thinness of the septum lucidum will permit a similar correspondence in the action of the liquid of the ventricles.

I have now, then, mentioned the function of the organs of sense or sensation; and described the three functions of intellectual operation, namely, perception, understanding and reasoning, with their results—ideas, emotions and passions. It remains to describe the function of the cerebellum—volition.

VOLITION is applied to the action of this part of the organ when it is considered with reference to locomotion; but, when not viewed with reference to this, it is termed judgment or opinion. Either the one or the other will obviously depend on the strength of the preceding cerebral impulsions. A vague and weaker series may be expended in the organ itself, and will merely be denominated *opinion;* a more powerful and definite will receive the appellation of *judgment;* and the most powerful, being instantaneously propagated to the cerebellum and producing evident locomotion, will receive the name of *volition.* Hence, volition must be implicitly dependent on intellectual operation, as that is dependent on sensation, and it, upon external impression *.

Having thus briefly explained the three functions of the nervous system—sensation, mental operation and volition, it re-

* Muscular motion, as dependent on volition, is explained in the paper on the intellectual functions, in the Second Volume of the Archives.

mains to explain their three accompanying circumstances—consciousness, memory and imagination.

As to CONSCIOUSNESS, I have shown, in this, and more especially in a previous paper already referred to, that, from the peculiar arrangement of the particles of the nervous system and the intimate relations which subsist between them, no particle can be deranged without affecting all the rest; every action must be cognizable to the whole; and the actions of other systems can be cognizable only by means of it. From this single property, consciousness arises. It differs from sensation in this, that that function refers to external operations; this, to internal. It is nothing more than the cognizance which thus the sensorium commune has of its own operations.

As to MEMORY, it is only a more or less accurate repetition of former intellectual operations re-induced by succeeding ones, and will, consequently, be more or less perfect according as intermediate operations may have been of the same or of a different kind. Now, I have, in the previous paper, shown, that that which undergoes frequent or powerful impressions of any one kind, will inevitably have its form modified by their action; and that whatever new impressions or new impulses it may then receive, it will, from its better adaptation to them, have a tendency rather to repeat those acts to which its figure is perfectly accommodated than others to which that figure would present a resistance. Thus, that which has, in any way, acquired a conical figure, whatever may be the peculiarity of the impulse upon it, will tend to perform one species of motion, and that which possesses a cylindrical one, will tend to perform another: thus, the peculiar forms which frequent impressions produce will uniformly lead to a similar peculiarity of action; and, thus, whatever impulses or impressions may be inflicted, they will, in the simplest manner, be associated with those motions which the object is, by frequent repetition of them, best adapted to perform. Nor can it, in this case, be of the slightest importance whether the substance, of which the form may be thus modified and the actions thus associated, be of earthy, ligneous, or nervous matter. To all this, then, does the function of memory in the nervous system correspond; the reason why previous actions are reexcited in the brain by impressions similar to those which first produced them is developed; and the cause why these operations must be less perfectly reexcited, when intermediate impressions and operations have been of a different kind, is apparent.

As to IMAGINATION, it differs from memory, which consists in the reexcitement of precisely similar operations, only

in this, that it reexcites and traces the analogies between operations only partially similar; or brings together and combines circumstances, the existence of one of which leads to the conception of, and appears to require the existence of others. Its peculiar mechanism requires no explanation after that of memory, as it only differs from it in reexciting impressions more loosely connected, or rather resembling only in particular points *.

In thus rapidly viewing the physiology of the nervous system in general, and of the brain in particular, I have only further to notice the involved arrangement about the medulla oblongata. Now, the transverse bands seem uniformly to serve the purpose of conducting the cerebellic origins of the nerves; and the division of the medulla into numerous fasciculi, with the converging radii of each, seem formed to communicate more powerful impulsions to the fluid of the ventricles, as has already been mentioned.

The ganglia of the nerves, too, I might have mentioned, do not, as has been imagined, render the actions of the parts placed beyond them involuntary, but merely prevent the actions of parts which are involuntary (solely because they are excited to act, not by the organ of volition, but by stimuli acting on their internal surfaces) from reaching the sensorium commune and unnecessarily disturbing the voluntary operations of the mind †.

All these, however, are considerations quite subordinate to the general theory which I have delivered, and the leading characteristics of which are, first, the general course of nervous action from the cerebral to the cerebellic nerves (the encephalic terminations of the former and origins of the latter of which, as well as the arrangement of the medullary substance in general, I have, I believe, first pointed out); and, secondly, its easy applicability to the explanation of the intellectual phenomena.

The previous theory, it must also be remembered, is only that of the functions of the intellectual organs—intellectual action, or mind, and not that of soul, with which physiology cannot interfere, and for which I have too high a respect to employ upon it my very inefficient labour.

* Instinct and sympathy need not be dwelt on here, as in the paper on the intellectual functions, they are shown to be referable to experience and reasoning.

† See the paper on the intellectual functions, already referred to, for a further illustration of this and many other points.

ON THE AZOTE DISENGAGED BY RESPIRATION.

BY M. M. PEPYS AND ALLEN.

At the Royal Society, on the 22d of June, some interesting additional observations by Messrs Pepys and Allen were read, on the azote disengaged by respiration. The authors, in all their experiments on this subject, found, that a considerable quantity of oxygen was lost in the process of respiration, and that azote was formed; that an animal can breathe oxygen and hydrogen an hour without any inconvenience, but that hydrogen alone occasions sleepiness. The term azote, they observe, is an indefinite name for all gas that is incombustible, irrespirable and inabsorbable by water; but, from professors Davy and Berzelius's experiments, they conjecture that it is really of a metallic origin.

ON THE RELATIVE INFLUENCE OF PARENTS ON OFFSPRING.

BY MR. T. A. KNIGHT.

A letter was, on the same evening, read from Mr T. A. Knight, on the relative influence of the male and female on the size and character of the offspring. Contrary to the opinion of Linnæus, Mr K. considers the female as influencing the character, but opposes Mr Cline's opinion, that large females should be used for breeding; because, although their legs will be longer in proportion to the size of the fœtus, yet, he thinks, their bodies will want the due proportion of depth and thickness, and the animal will be less vigorous and powerful. Thus, for instance, foals of large mares and small horses have the chest thin and narrow, whereas the contrary is the case with those of small mares and large horses. Mules from large mares the author found unserviceable from their want of proportion, and consequently want of strength.

MISCELLANIES IN PHYSICAL SCIENCE.

BY THE FRENCH NATIONAL INSTITUTE.

Mr Delambre, perpetual secretary, has given an analysis of the labours of the mathematical division of the class of mathematical and physical sciences for the year 1807, of which the following is a brief account.

Mr Burckhardt has proposed a mode of constructing telescopes, which he conceives will render their use more easy and convenient, than any yet adopted. His smaller mirror is plane, like Newton's, but placed perpendicular to the axis of the large concave mirror, and at half its focal distance. In this place the section of the reflected cone of light is a circle, the diameter of which is just half that of the large mirror. Accordingly the small mirror intercepts a fourth of the direct rays, but Mr. Burckhardt compensates this loss, by increasing the dimensions of the large mirror a little. The cone thus intercepted takes an inverted direction; and the rays, instead of proceeding to their focus behind the small mirror, unite at an equal distance in front of it, passing through an aperture in the centre of the large mirror. The telescope, thus reduced to half its length, will have four times as much light as a common reflecting telescope of the same length. Many objections were made to this construction, which Mr B. answered, and it was agreed, that one should be made for trial.

The astronomers, who have lately measured the meridian line between Dunkirk and Barcelona, have employed Borda's circle to determine the time for correcting their clocks. They presume, that in an interval of four or six minutes, during which four or six observations may be taken, the altitude of the sun or a star increases with sufficient uniformity in proportion to the interval, so that a mean between the observations may be taken, and employed safely as a single observation.

Mr Delambre and Mr Burckhardt give several useful formulæ for taking altitudes of the stars, and likewise of the moon, with precision. Mr B. likewise proposes a new method of determining the moon's node.

Mr Biot, before his first journey into Spain, had determined by nice experiments the refracting power of the air and

of gasses, which he found to differ very little from what Mr Delambre had inferred from his astronomical observations combined with those of Mr Piazzi. It is well known, that refraction varies with the state and temperature of the atmosphere; and astronomers have long applied two corrections, one from the height of the barometer, the other from that of the thermometer. Since the introduction of the hygrometer, it has been questioned, whether this ought not to be employed for a third correction. During near a month, that Mr Delambre spent in the steeple of Boiscommun, at a time when severe frosts more than once succeeded very damp mists, he endeavoured to ascertain, whether the variations of the hygrometer were attended with any change in terrestrial refraction, and found not the least indication of such a change. Mr Laplace had made the important remark, that the refractive powers of air and the vapour of water, at equal degrees of elasticity, differed very little; but the question was of sufficient importance in astronomy, to be brought to the test of direct experiments. This Mr Biot has undertaken. He first ascertained the effect of vapour alone. By means of potash he dried the warm air included in his prism, while that without was loaded with all the natural moisture of the atmosphere. The pressure of these two airs, indicated by a barometer within, and another without, was not the same; the difference being equal to the tension of the atmospheric vapour. The deviation of the luminous ray in the prism then gave the refraction produced by the vapour; and this never differed from what would have been produced by air alone at a similar temperature more than a few tenths of a second. The mean was 0.15″. Hence Mr Biot infers, that the refraction produced by vapour in the atmosphere may safely be neglected in astronomy.

[It has here been properly observed, that observations by some of the members of the Asiatic Society at Calcutta lead to a different conclusion.]

Mr Messier has given a beautiful delineation of the nebula in Orion, to which he has added that of Legenti, and another much more difficult to perceive, which he himself discovered in 1773.

He has likewise collected all the particulars of the thunder storm, that burst over Paris on the 21st of October, 1807; and the not less extraordinary gale of wind, that occurred the next day. In the observations he has registered for fifty years he finds nothing similar to it. The church of Montivillers was struck by lightning during a storm equally violent, that took place on the 8d of November following.

On the 21st of October, Mr Pons discovered the comet at Marseilles. It was then austral, near the horizon, and set soon after the sun. It was seen a few days after by different astronomers in France and Germany, and at Madrid. Mr Burckhardt has calculated its orbit.

Mr Burckhardt has found in the archives of the Imperial Observatory some unpublished observations of the comet of 1701, seen at Pau by Father Pallu. He suspects it is the same as was seen at sea in February following. Having found an important observation of the comet of 1672, he has calculated its elements afresh, and finds its perihelion distance greater than was before assigned; whence he infers, that it could not be the same with that of 1805, which some had supposed.

Mr Bouvard has accomplished a more important and more generally useful task, corrections of the tables of Jupiter and Saturn; and Mr Delambre has availed himself of these in the ecliptic tables of Jupiter's satellites, which he has entirely reconstructed, and will shortly publish.

The only paper in physico-mathematics mentioned is Count Rumford's, (already known in England).

Beside the Memoirs of the Institute, the second volume of the "Base of the Decimal System of Measures" has been published. It contains the remainder of the observations of all kinds, and the calculation of the triangles from Dunkirk to Barcelona; the heights of the signals above the surface of the two seas; the azimuths and the latitudes of the five principal stations. The third and last volume is in the press.

Mr Berthoud, who died in August 1807, had published a few days before his death a supplement to his treatise on Timekeepers, with an account of his researches from 1752 to 1807.

Mr Betancourt presented to the class a model of a lock on the same principle as that invented by Mr Huddleston. He has likewise given a mathematical discussion of the principles, on which it ought to be constructed, so as to be manageable by the strength of one man.

Mr Lancret has considerably extended Mr Monge's theory of evolutes.

Mr Malus, of the corps of engineers, has deduced from a uniform and general analysis the various circumstances of the propagation of light, and a solution of the fundamental problems of optics. By a theory entirely new, founded on the properties of the intersections of a series of right lines, drawn, according to a constant law, to all the points of a given surface, Mr Malus has determined the course of refracted and reflected

rays; the intensity of light, in all cases, at any given distance from the luminous point; and the place, form, and magnitude of images. He shows, that in certain cases, and with certain surfaces, reflection and refraction produce images, that are erect in one of their dimensions, and inverted in the other, a circumstance never before noticed.

The propagation and reflection of sound have some resemblance to those of light, but their theory is attended with more difficulty. As the velocity of sound is very small, it might be questioned how far it depended on a simple law. Messrs. Lagrange and Euler, who first treated this problem, supposed it in a particular case to depend only on its distance from the centre of motion. Mr Poisson has just demonstrated generally, in a very ingenious manner, that the law is always the same: that the movement is propagated by spherical undulations with the same velocity in every direction; but that the vibration of particles situate at the same moment in the sonorous wave are made with unequal rapidity, according to a law depending on the nature of the primary agitation; and consequently, that the intensity of the sound, which depends on the velocity of these vibrations, is thus found to be different in different parts of the sonorous wave. The velocity in a given radius decreases in the ratio of the distance; whence it follows, if the intensity be proportional to the square of the velocity, it must decrease in the proportion of the square of the distance.

Only two determinate roots of the general equation had been found, but the formulæ of Mr Poisson comprise an infinite number, by which may be verified all the theorems he has obtained in the general case, to which he first paid attention. He afterward considers the case where there are several causes of a simultaneous vibration; and without affecting the generality of the root, he decomposes it so, that the different parts answer to the different centres; which leads him to give in a novel and ingenious manner the theory of the reflexion of sound, and production of echoes; and to show what would take place between opposite and parallel planes. By a similar method he explains what must occur in the far more difficult case, where the mass of air set in motion is included in an ellipsoid. He demonstrates, that the sound, which originates in one of the foci, is reflected toward the other, making the angle of reflection equal to that of incidence, and following the same laws as light. These results are conformable with what we have learned by experience of elliptical vaults, but it was very difficult to demonstrate them mathematically, which Mr Poisson has done in a new and ingenious manner.

It has long been remarked, that the observed velocity of sound is superior to what is deduced from algebraical calculations. It may be conceived, that the density and temperature of the air have some influence in this; but Mr. Poisson demonstrates, that they are insufficient to explain the observations. Having examined successively the causes supposed by Newton and other geometricians, he finds them incompatible with the results of sound philosophy. Mr Laplace attributes the acceleration of sound to the change of temperature experienced by the particles of air in their condensation and dilatation, which cannot take place without a successive evolution and absorption of heat. Calculation applied to this hypothesis, or rather incontestable fact, shows, from experiments made by the Academy of Sciences in 1738, that a dilatation or condensation of $\frac{1}{116}$ produces a change of temperature equal to a degree of the centesimal thermometer [1·8 Fah.].

The labours of the physical division of the class have been analysed by Mr Cuvier, perpetual secretary.

In 1804, the class had awarded a prize to Doctors Herholdt and Raifn, of Copenhagen, for a paper on the winter sleep of animals; and, in 1807, another to Dr Saissy, of Lyons. Prof. Prunelle, of Montpellier, has since sent a paper, that may rank with the best on the subject. Still however, notwithstanding their researches, and those of Spallanzani, Mangili, and Carlisle, we are ignorant of the causes, by which certain animals are disposed to this sleep, and not others, as well as of those that enable them to endure this suspension of their functions.

Mr Geoffroy-Saint-Hilaire, Prof. at the Museum of Natural History, elected to succeed the late Mr Broussonnet, presented to the class some fragments of a great work, which he has undertaken on comparative osteology. His object is to investigate more minutely the analogies between the corresponding parts of various animals with vertebræ. In fact those parts of organs, that are always found more or less similar in number and position, notwithstanding their difference in size and use, and contradictoriness to all apparent final causes, must necessarily depend on efficient and formative causes. As these must be connected with the primary means employed by nature, if we may flatter ourselves with ever throwing any light on the origin of organized bodies, the most obscure and mysterious point of natural history, it seems to us the first sparks must be derived from these analogies of structure.

Mr Dumeril, prof. of anatomy at the Medical School, presented three papers. In the first he treated on the mechan-

ism of respiration in fishes, and pointed out some interesting singularities. Those that from having their mouths sometimes affixed to stones, or buried in mud or sand, cannot always use them for taking in water, are provided with apertures for admitting the water on dilating the cavity of the month, and these apertures are furnished with valves internally, to prevent the water from returning by them, so that it has no exit but by the gills.

The second was on the taste and smell of fishes. Mr D. supposes, that the tongue, from the dryness and hardness of its integuments, and the constant passage of water over it, must be insensible to flavours; and that the pituitary membrane, not being exposed to the impulse of elastic vapour, cannot be the seat of smell like ours. This membrane therefore he conceives to be the organ of taste.

The third is a comparison of the various vital and animal functions in the order of reptiles termed *batrachian*, which justifies its division into two families.

Several other papers on reptiles have been produced, particularly on crocodiles, of which Mr Cuvier has shown that no less than twelve distinct species exist in the old and new world.

The same naturalist has endeavoured to remove by dissection the doubts entertained respecting some reptiles of a singular form, which truly deserve the name of amphibia, because they breathe both with gills and lungs. One of these is the siren lacertina, another the proteus anguinus, and a third the proteus pisciformis. The two former of these at least have the skeleton too firmly ossified, and too different from those of any other reptile of their native abodes, and besides their organs are too perfect, to admit of their being considered as tadpoles, that have a change to undergo. The last inhabits the lakes of Mexico, where it is used as food, and resembles a water lizard, except in having gills. It is called there *axolotl*, and was brought over by Humboldt.

Mr Biot, while employed in measuring an arc of the meridian at the Balearic Islands, thinks he has observed, that part of the intestines of fishes caught by a hook and line at great depths, and drawn up suddenly, issue out of their mouths, which he attributes to the expansion of the air-bladder. He has likewise examined the nature of the air in this bladder, and found it to vary from pure nitrogen to a mixture of this gas with 0·87 oxygen, but he discovered no hydrogen. It appeared to him, that, the deeper the fish lived under water, the more oxygen the air contained.

Mr Jurine is extending his new method of classing insects, which is found to be more natural than could have been expected, to the diptera.

Mr Dupuytren, head of the anatomical department of the Medical School, has shown, that the concurrence of the nerves of the lungs in the act of respiration is necessary to the conversion of the venous blood into arterial.

The science of botany has been sedulously pursued. Mr de Labillardiere has finished his Flora of New Holland. Mr Dupetit-Thouars continues his researches on the growth of vegetables. He still thinks, that the trunk of trees has the principle of its increase in the buds; and that the fibres composing the annual layers of wood are in some sort the roots of the buds, while the little medullary thread terminating each bud performs the function of cotyledons. He has endeavoured to answer objections, and brought forward many interesting facts. Among these is the germination of the *lecythis*. The evolution of the seed of this tree, which is dicotyledonous, cannot be referred to either of the three modes hitherto adopted. Its cotyledon is interior, and serves as a base to the pith, which Mr D. T. thinks a proof of the justice of his opinion. The cuttings of the willow, that take root though deprived of their buds, seem to furnish a strong objection to it; but he has found, that in this case little subsidiary buds are unfolded opposite to the points that were occupied by the stipules of the leaves.

There is no subject of more general importance in the vegetable economy than the origin of the carbon of plants. Mr Crell, the celebrated chemist of Helmstadt, has this year communicated to the class some experiments, that seem to give a very high notion of the power of vegetation. He asserts, that he has made plants grow and produce seed in pure sand, watering them only with distilled water, and supplying them with a given quantity of air, in which the carbonic acid must be almost as nothing in proportion to the carbon produced. It is to be observed however, that, though the plants were covered with a glass, he could not prevent the access of external air through the sand.

PATENT OFFICE LIBRARY.

FOURTH DEPARTMENT OF SCIENCE, OR LITERATURE.

SKETCH OF A GENERAL THEORY OF NATURAL AND UNIVERSAL LANGUAGE.

BY THE EDITOR.

It has long been complained by philosophers that all known languages consist of signs which are arbitrary and vague. That, in this, they were correct, will readily be granted, when it is recollected that these signs are, in all languages, so indefinite as to change their meaning with every change of attitude and tone. This perhaps may be traced to another defect, namely, that the number of sounds which individual languages employ are much fewer than those which the human voice can, with facility, pronounce; and it is even probable that all the vowels, consonants and liquids which the human voice is capable of pronouncing, together with their simplest combinations, do not exist in all the languages of the earth, even collectively considered. And this last defect is heightened by a third, namely, that several, even of the few sounds employed in individual languages, are frequently represented by one written sign.

Even of the fine arts, which come in aid of language in the expression or excitement of ideas, emotions and passions, each has its limited province and its peculiar defects. While poetry wants the melody and harmony of music, music wants the distinct articulation of poetry, and while gesture, as generally practised, wants the correctness and dignity of sculpture and painting, these arts want the flexibility of gesture.

These defects of languages have not been without their consequences. Vague signs were incapable of exciting definite ideas; and doubtless, from the want of a perfect medium

of their communication, most of the disputes which have been fatal to the happiness of man must have originated; for, misconception and error, even in physics or in literature, quickly lead to others in morals and in politics.

Impressed by such considerations, Dalgarno, Wilkins and Leibnitz attempted to construct that which they termed a Philosophical Language. But their principles were, in many circumstances, more arbitrary, and, in all, more at variance with the feelings of mankind than any one of the languages which they wished them to abandon. Their schemes were formal, aukward, repulsive to those sentiments which have influenced the formation of all languages, and utterly inadequate to produce the effects of a philosophical language *. The systems of Wilkins and Leibnitz, indeed, though preferable to existing Languages in point of method, are under another and infinitely more important consideration, altogether inferior to them. They are destitute of the finest characteristic of existing Language—that characteristic by which they most of all approximate to natural Language and which in some degree, belongs to all of them—the natural connexion subsisting between objects and their signs.

Some persons have, moreover, wished, in place of the great variety of alphabetic and considerably arbitrary characters now used in different nations, to effect the substitution of one consistent series of altogether arbitrary, but universal characters which, on the plan of the arabic numerals, should be the signs of all the Languages of the earth, though not necessarily connected with the sounds of any of them. Such schemes, however, have no claim to the comprehensive title of philosophical and universal Language, as they admit of being applied only to a single division of it, namely, Written Language. Besides, one observation will suffice to show the bad consequences which would result from the success of such attempts, were their success possible. For if we except numerals and such classes of words, there are not probably in all the languages of the earth two terms exactly synonymous, and this indeed is the principal cause why even the best translation cannot possess the spirit of its original. It appears, however, that as long as each nation retains its own peculiar written characters, there will be some room left to imagine that at least slight shades of meaning may separate some of those words which, in different languages, are said to correspond most exactly. But, were this plan adopted, words which, though

* The cause of these defects will appear from the sequel.

generally called corresponding, are yet separated by the most distinct shades of meaning, would be, as it were, consolidated by one character, ideas would be confounded, error and ignorance would be perpetuated and eternized.

1. DIVISION. OF THE ELEMENTS AND FIRST PRINCIPLES ADOPTED IN THE PRIMARY CONSTRUCTION OF ALL LANGUAGES, VIEWED IN THEIR RELATION TO NATURAL AND MORE ESPECIALLY TO EXISTING LANGUAGES.

As, then, individual languages are avowedly defective, and yet all appear to have been, in however slight a degree, constructed upon the supposition of a natural connexion between objects and their signs, and as the fundamental defect of the various schemes of philosophical language appears to be their abandonment of that principle, it becomes extremely desirable clearly to ascertain its existence, accurately to define its nature, and nicely to trace its applicability even to the construction of an universal system. Hitherto, however, even the existence of natural principles have been but vaguely hinted at, no attempt has been made to ascertain their nature, and their application to an universal system has not even been imagined.

Hinting at their existence a respectable author has vaguely yet justly observed, that among different languages, even where we cannot suspect the least connection or communication, it is found, that the words, expressive of ideas, the most compounded, do yet nearly correspond to each other: a certain proof, that the simple ideas, comprehended in the compound ones, were bound together by some universal principle, which had an equal influence on all mankind.

Even on this vague ground, granting, for a moment, such a principle to exist, it must appear that, by neglecting to determine its nature, and to trace both its actual applications and its possible applicability, the foundations of a science of the utmost importance have been disregarded, and philology or literature has been left in obscurity. For, the advantages of such an investigation, even though we entirely neglect its application to philosophical and universal language, or rather to what I should term natural and universal language, will obviously be to illustrate the primary construction of language in

general, and probably to contribute to its improvement on principles which as they are its own, must be perfectly congenial to it.

Advantageous then as even a mere speculation of this kind might be, it becomes infinitely more so when applied to develope the intimate nature and improve the practical applications of every individual language, and renders the study of natural principles incomparably more interesting than the chimerical plans of Wilkins and Leibnitz. The impossibility of their ever being practically adopted, divests them, indeed, of all interest, while the circumstance that natural language affords the foundation, pervades the structure, and confers all the beauties of iudividual languages, as will hereafter more fully appear, confers on it interest of the highest degree.

But, before I can proceed further, I must firmly establish the existence, and accurately define the nature of these principles, for even this first portion of the task is yet unperformed. I shall first, therefore, show that there is a natural connexion between ideas and figured signs, which may be termed a written language; secondly, that it similarly exists between ideas and the movements of features or attitudes, which may be termed an acted language; and thirdly, that it also exists between ideas and sounds, which may be termed a spoken language.

The fact which I now state with regard to this natural connexion is the very foundation of all the fine arts as well as of language. If no natural connexion subsisted between ideas and figured signs, sculpture and painting would give no impression to the mind; if a similar connexion did not exist between ideas, and attitudes and the movements of features, gesture and physiognomy would be equally inefficient; and if it did not also exist between ideas and sounds, poetry and more especially music would be useless. But let us consider each of these subjects separately.

1*st*, *Of the Elements and Principles of written Language.*

That various combinations of forms and colours have a natural connexion with ideas, and are well calculated to represent them in written language, will appear very evident to all who, for a moment, consider, that precisely such combinations excited these ideas. For, almost all nature is cognizable to us by the senses of touch and of vision, yet these make us acquainted only with forms and colours; by forms and colours, therefore, may all these objects be re-expressed. This is the

foundation of sculpture and of painting; and this must also be that of a written natural language, if such a language were possible.

But we are told that picture writing was practised only by barbarous nations, and that the adoption of arbitrary characters in lieu of it was a step of high civilization. This, however, is an assertion totally unsupported either by reasoning or by facts. As to reasoning; it is very obvious, that the figures of objects, had they been at that time correctly adopted, need no more have expressed individuals than the arbitrary signs we use; that they might have been quite as general as they; and that, thus generalized, they would have admitted of far more rapid formation *, while at the same time they could not have failed to produce among all nations one similar, unequivocal and intuitively intelligible idea. For, had the picture writing of Egypt not degenerated into fanciful and arbitrary hieroglyphics, and had that of Mexico ever risen above similarly fanciful and arbitrary symbols—had correct and natural picture writing been adopted in both nations, the individuals of both, if time and chance had ever led to such a circumstance, might have held unpremeditated yet perfectly intelligible communication with each other. If, as to facts it be argued, that the Egyptians were more barbarous than those who changed their degenerated hieroglyphics into arbitrary characters, this I deny. These arbitrary characters must, in the first instance, have been incomparably more vague than the mutilated picture writing for which they were substituted, and it has only been after a series of ages, that they have become fixed and definite. To compare, however, in value perfect arbitrary with imperfect natural signs, would be unfair in the extreme, though it cannot be controverted, that, in abandoning natural signs, a step was made, not to, but from, civilization, and an unscientific method was adopted in lieu of a scientific one—a method which led to an infinite multiplicity of arbitrary languages, instead of one natural and universal one. For, it is eminently worthy of remark, that while mankind were, in the early ages, following the obvious dictates of nature in endeavouring to express objects and actions by their pictures or their natural signs—while they were attempting to construct a natural written language, they had all one and the same object in view, and had they persevered, all would have attained that one object, the same

* At all events, their adoption would have been attended with less expenditure of time, for even were they of slower formation, it would have prevented the loss of many years to all who acquire a number of languages, as all well educated persons do.

language differing only as the appearances of nature differ, would have obtained in every nation under heaven, and all the people of the earth might have held unpremeditated yet perfectly intelligible communication. . . . Such has been the inexpressible loss attending the abandonment of natural and the adoption of arbitrary signs. Instead of one fixed and definite language we have many which are vague and indefinite.

It is, however, worthy of remark, that many of the arbitrary characters in all languages are still mutilated natural signs, as the Roman *i* and *o*.

Now picture writing is applicable, not only most naturally, most correctly, and most rapidly to express external objects, but even to express the acts of the mind.

It is certain that some forms, accompanied by peculiar colours, excite in the mind definite ideas and strong emotions; and it is also certain, that every colour does not equally heighten the effect of a particular form: and hence the colours which heighten most the effects of peculiar forms, may be denominated corresponding. But, the corresponding forms and colours which excite in the mind the most definite ideas and the strongest emotions, though perhaps complicated, are certainly not the simplest in nature; nevertheless each of the simple elements of these very forms and colours must be capable of producing singly the portion of effect which in combination it contributes; and as every simple colour cannot equally heighten the effect of a particular simple form; hence also it follows that the simple colours which heighten most the effects of peculiar simple forms, must also be denominated corresponding. Thus each simple form has a corresponding simple colour, and the more of this correspondence that exists in the combinations of nature and of art, the stronger are the impressions they give to the organs of sense.

I am aware that to speak of pictures of ideas, may seem strange to some; but persons of susceptibility and taste not only feel, but can, in a considerable degree, define the ideas which the very simplest colours excite; and these, by the bye, can much more difficultly be defined than those which are complex, because, in them, each simple colour contributes a small portion to a general and great effect. If, then, simple colours be capable of exciting ideas, re-exhibited, they are equally capable of designating and re-exciting them. Thus they become, as it were, the pictures of these ideas. If it be insisted that even to persons of the most exquisite susceptibility and the most refined taste, it is extremely difficult to define the ideas which simple colours excite, this, while it cannot be a

proof that they never may be defined, exactly proves that these colours alone can, in a written language, designate and re-excite the ideas which they originally excited, and that they therefore ought most necessarily to constitute part of a natural language.

In short, this principle, however careless we may be of defining it, blends itself with all our sensations, and influences all our actions, in the greatest and most important as well as in the least and most trifling circumstances. It is upon this principle, that the greatest scenes of nature affect us, and it is upon this also that we choose objects of certain forms and colours, and refuse others which present less agreeable combinations.

So much, then, with regard to the nature even of those forms and colours which are most difficult to define. Stronger arguments, however, prove the facility of expressing the operations of the mind by natural written signs. . . . In former papers, I have shown that all mental operation, like operations in general, consists of the motion of peculiar forms, or rather of the transmission of various series of motions commencing from external objects and terminating in the muscular and locomotive organs. Hence, the actions of the brain, or the operations of mind, have the strictest dependence upon, and the closest analogy to the external actions which precede and excite them, and must be as easily expressible by natural written signs as they. The difficulty, however, of tracing and analysing these operations must alone have intimidated persons from attempting to construct correct natural signs of them. Conscious that the terms strength, velocity, &c. were as applicable to the brain and its acts as to other physical objects, yet very properly dissatisfied with such complex and absurd hieroglyphical or symbolical representations of them, as lions, eagles, &c. and too ignorant and negligent to search for simple and natural signs, they entirely abandoned them, and adopted arbitrary characters, precisely upon the same principle and from the same motives that the most ignorant of the present day place their arbitrary mark—a cross, perhaps, in lieu of their name, and leave to others to form its detailed explanation.

From all this it follows that those pictures which represent objects and excite ideas, alone can constitute a written natural language. They alone can correctly designate objects, and again give the impressions which these objects originally gave.

2dly, Of the Elements and Principles of Acted Language.

Mankind are endowed with forms equally capable of receiving impressions and of designating the objects which give them, and so of giving them again. Yet all these beauteous outlines which at once give elegance and happiest expression to the human form are voluntarily employed only as concomitants in the most necessary or most vulgar actions.

Now, as shown in a previous paper, it is by peculiar motions that objects give impressions to the organs of sense; it is by the continuation of these motions that corresponding impressions are conveyed to the organ of intellect; and it is still by their continuation that they are transmitted to the organs of expression or the muscular and locomotive parts of the body. Thus, an evident motion takes place in impression, a less evident, but still acknowledged one in mental operation, and again an evident one in the acts of volition. But, motion not only demonstrates itself in impression, seems continued in judging, and again evidences itself in expression; but, beautifully corresponding to the laws of the most evident species of motion, it does not terminate here without communicating new and similar motions—another series of ideas, emotions and passions o other minds.

Now it is obvious, that the motions or attitudes adopted, being very various, as well as the thoughts or the objects which they are intended to designate, must be bound together by some tie—must have a natural connexion and implicit dependence upon each other. One cause does not naturally produce various and different, but peculiar effects; these form a regular and dependent series. However, arbitrary, therefore, we may render the acted signs of ideas, we can only pervert, but do not destroy a natural and universal principle. As each cause naturally produces its peculiar effect, so in each mental process, the forms of the series of motions of which it consists, must be naturally peculiar, appropriate and similar to each other throughout. Indeed, without this being the case, the phenomena could not occur; for if, in the organ of intellect, for instance, one particular mode of action, were the consequence of various and different actions in the organs of sense, then, one peculiar series of muscular actions would inevitably be the result of various and different impressions.

When the idea of any object is, therefore, excited, a portion o the organ of sense, precisely similar in form to the im-

pressing body, is affected, a motion of the parts corresponding to that impression is conveyed to the sensorium; and, when unperverted by arbitrary and unnatural habits, the muscles are correspondingly actuated. In each individual process, the forms of these motions must be the same throughout, and when, in order scientifically to express the ideas which these motions formed in the brain, the various muscles of the body are actuated, we only repeat them externally. Hence it is, that the motions which, in scientific gesture, our muscles perform, are in reality, mere imitations of the forms of the bodies which impressed our senses, and which we wish to describe, or mere repetitions of those forms which have just preceded in the organ of intellect *.

From all this it follows that attitudes and movements resembling those forms, &c. intended to be designated alone can constitute an acted natural language, because they alone can designate them and again give the impressions which those objects they designate originally gave.

3*dly*, *Of the Elements and Principles of Spoken Language.*

The various sounds produced by the voice are as naturally and implicitly connected with the operations of the mind and the external impressions exciting them, as the movements of the muscles are. Indeed, they correctly depend upon these movements, and are produced by them, in the most regular and invariable way. They are the results of the muscular actions of the organ of voice, when air is impelled through it from the lungs. Thus, their natural connexion with these motions, and consequently with the mental operations producing these motions, and with the external impressions exciting these, is obvious and implicit.

As, however, this intimate connexion between peculiar sounds and peculiar ideas may, at first sight, be less apparent than that between these and written figures or acted signs—a written and an acted language, it may be worth while to illustrate it in particular. In doing this, I shall rather consider sounds themselves than the signs which we use of them, and which frequently represent several sounds. Where one sign, therefore, represents several sounds, I shall repeat it for each, attaching to it, at the same time, a distinguishing mark.

* These two last paragraphs afford also a more detailed illustration of the principle upon which natural written signs, which were last considered, must have been formed if their study had ever been actively prosecuted.

I am not of opinion that these sounds have ever been correctly arranged—that is, according to their relations to each other—relations which are founded on their similarity to the ear and also in their mode of production. Nor do I, on the other hand, mean to say, that philologists have erred in every respect concerning them. Their errors, however, have not been inconsiderable.

These sounds naturally arrange themselves into four orders, of which those may be reckoned the FIRST of which the pronunciation cannot be rendered continuous*. Their signs are,

k	*t*	*p*
g †	*d*	*b*

These naturally arrange themselves into three genera, of which each contains two species. Thus *k* and *g* are the first and second species of the first genus; *t* and *d* are the first and second species of the second genus; and *p* and *b* are the first and second species of the third genus. The first genus is distinguished from the rest by being produced furthest backward in the mouth—between the tongue and palate; the second genus, by being produced intermediately—between the tongue and posterior superior part of the upper incisive teeth; and the third, by being produced furthest forward in the mouth—between the lips. The second species of each of these genera differs from the first in having a kind of bass tone superadded to it. And the whole order is distinguished from every other order of sounds, in this, that each sound of which it consists requires the momentary contact, and, as it were, impulsion upon each other of the parts of the organ by which it is produced. It is this particular circumstance of momentary contact or impulse that renders it impossible to continue any sound of this order, however it may be repeated.

Those sounds form the SECOND ORDER, which bear a very strong analogy to the preceding ones, but of which the pronunciation, like that of a succeeding order, may be continued though less distinctly than they *. They are,

h' †	*th'* ‡	*f*
h` §	*th`* ‖	*v*

* These are a portion of what are commonly termed consonants.

† As in *goat*, *goose*, &c.; for, as pronounced in *genius*, it is not a simple, but a compound sound, consisting of *d* and *j*.

* Some of these have been termed semivowels.

† As in *haste*, *help*, &c. ‡ As in *think*, *thought*, &c.

§ A more bass sound, not used in English. ‖ As in *this*, *that*, &c.

The sounds of this order also naturally arrange themselves into three genera, of which, as in the preceding genus, each contains two species. Each genus of this order is pronounced at the very same part of the mouth with the corresponding genus of the preceding order, unless, perhaps, we except the last. Thus *h'* and *h`* are pronounced where *k* and *g* are; *th'* and *th`* where *t* and *d* are; and *f* and *v* where *p* and *b* are, except that, while *p* and *b* are produced entirely by the lips, *f* and *v* are produced by the under lip and upper incisive teeth. But while these two orders are thus pronounced at similar parts of the mouth, the last does not, like the first, require the momentary contact or impulsion of the parts, but, on the contrary, requires their separation, though in a very slight degree. . . . Like the sounds of the first order, the second species of each genus of this order differs from the first in having a kind of bass tone superadded to it. But the whole order still differs from the preceding one in this, that each sound of which it consists does not require momentary contact or impulsion, but slight separation of the parts producing it. And it is the absence of this contact or impulsion that renders it possible more easily to continue any sound of this order, though not with the utmost distinctness.

These two orders, bearing this general analogy, ought to be considered in connexion and compared with each other, thus:

k	*t*	*p*
g	*d*	*b*
h'	*th'*	*f*
h`	*th*	*v*

Very closely connected with this last order are other four simple sounds, which may be deemed the THIRD ORDER, viz.

s	*sh*
z	*j**

I have not, however, placed them in the preceding order, because they differ considerably from its sounds, both in the mode of production and in effect, and because they lose that analogy to the sounds of the first order which the other sounds of the last order possess. These sounds consist of two genera, of which each contains two species. Both genera require the tongue

* Pronounced as in French, or as *z* in *azure*.

and incisive teeth in pronouncing them; the first being closer, however, than the last; and the second species of each ge us, being, as in the sounds last mentioned, accompanied by a bass tone. They bear a strong analogy to the last order; but I know not at present precisely where to arrange them.

From the arrangement which I have given of the preceding orders of sounds, the nature of cognate sounds is considerably illustrated, and the manner of their interchanges in various languages becomes apparent. It appears to me that they are mountaineers, who most frequently substitute the first or acute species of both the preceding genera for the second or grave ones ¶.

Those sounds form the FOURTH ORDER, of which the pronunciation is with the utmost facility continuous, and all of which are commonly termed vowels. They are,

*i** *e*† *e*† *a*‡ *a*§ *a*‖ *o*** *o*†† *o*‡‡ *u*§§ *u*‖‖

Of these sounds, the first is the slenderest which exists in nature, or which the voice can pronounce, and it is produced by the smallest and slenderest aperture of the mouth. From this to the last *a* inclusive, they gradually become broader or flatter, and are produced by a corresponding aperture of the organ. The *o*s are rounder, and the *u*s more tubular, and they also are produced by a precisely corresponding form of the organ of voice. It is owing to the absence of all impulsion or contact in the pronunciation of these sounds, and to the existence, on the contrary, of a peculiarly formed aperture in each, that they all possess the most unlimited continuity.

These sounds form the FIFTH ORDER, which have been

¶ Thus, it has been observed, the Welch, for the words,
'I *vow* to *God th*'at *J*enkin *is* * a wi*zz*ar*d*;' say,
'I *f*ow to *Cot th*'at *Sh*enkin *is* a wi*ss*ar*t*.

* As in *fin*, *fish*, &c.; for the English sound as in *fine*, *pine*, &c. is not a simple but a compound sound of the Italian *a* and this *i*.

† As the first *e* of the French word *verité*, &c.

‡ As in *met*, *let*, &c, ‡ As in *mate*, *fate*, &c.

§ As in *far*, *father*, &c. ‖ As in *wall*, *war*, &c.

** As in the open Italian *o* in *buona*, *cuore*, &c.

†† As in *note*, *mote*, &c.

‡‡ As in the close Italian *o* in *corona*, *persona*, &c.

§§ As in *bull*, *pull*, &c.; for the English sound as in *cube*, *tube*, &c. is a sound not simple, but compounded of *i*, as in *fin*, and this *u*.

‖‖ As in the French words *lute*, *lune*, &c. Our *u* in *cup*, *tub*, &c. is a compound: so also is one of the sounds of *y*, the other being the same with *i*.

* Pronounced as *z*.

most improperly termed liquids, although liquidity of sound belongs only to one of them. They are,

m n l r

M is pronounced by means of the lips, but differs from *p* and *b*, pronounced at the same place, chiefly in being at the same time a nasal sound. *N* is pronounced by the tongue and superior posterior part of the upper incisive teeth, but differs also from *t* and *d*, pronounced at the same place, chiefly in being at the same time a nasal sound. *L* is the only sound deserving the name of a liquid, and is produced by the breath gliding between the tongue and palate pretty broadly applied to each other *R* is precisely the opposite of *l*, and is produced by the breath passing, not glidingly, but interruptedly, between the same parts.

Having, thus, explained the general effect of these sounds, and the mechanism by which they are produced, we now arrive at a still more important consideration, namely, the close analogy which they bear to all the sounds which objects external to man can possibly emit—a consideration indeed of the utmost interest, because it is essentially necessary to enable us to trace how far, in the original construction of all languages, mankind have, by means of vocal sounds, endeavoured to express those of external objects, or the objects themselves which emit them.

First, then, with regard to the first order of sounds, or perfect consonants, it is very remarkable, that, as they are all produced by the contact and impulsion of the organ of voice, so all external bodies of a solid kind, if brought forcibly into contact, uniformly produce one or other of them, as may easily be ascertained by an attentive and delicate ear. The hardest of solid bodies, as metallic substances, when impelled upon each other, uniformly produce the sounds *k* or *g*, at the moment of their impulse; softer solids, similarly impelled, uniformly produce the sounds *t* or *d*, at the moment of their impulse; and the softest solids, under the same circumstances, uniformly produce the sounds *p* or *b*, at a similar period.

With regard to the second order of sounds, it is equally remarkable, that they are similarly produced by the impulsion of still softer bodies or liquids.

And, with regard to the third order of sounds, it is equally remarkable, that, as they are produced by the rapid passage of the breath between the teeth and lips, so, externally, aeriform fluids in rapid motion uniformly produce them.

As the fourth order of sounds are produced, not by the more or less perfect contact of the parts of the organ of voice, but rather by its variously formed apertures, so, externally, similar apertures produce them. Air rushing through a very small aperture, or a sharp point in motion, causes the sound *i*; air rushing through a larger flat aperture, or a flat body in motion, causes the sound *a*; air rushing through a round aperture, or a round body in motion, causes the sound *o*; and air rushing through a tubular aperture, or a similar body in motion, causes the sound *u*.

As, in the fifth order of sounds, *l* is produced by the breath gliding between the tongue and palate, so, externally, it is produced by all liquid motions; and as *r* is produced by the breath being interrupted in its passage between the tongue and palate, so, externally, it is caused by all interrupted motions *.

We have now, then, advanced to a still more interesting part of this disquisition—the fundamental principle which has operated in the construction of all spoken languages. This principle is, that, as the sounds of the human voice are capable of reexpressing all the sounds of external objects, and as these sounds of external objects are implicitly dependent on the forms and other qualities of the objects which emit them, the sounds of the voice are consequently also capable of designating these objects. And, in perfect consistency with this principle, all nations have, in the original construction of their respective languages, and more especially in the formation of their most beautiful and impressive words, used consonants as expressing the contact of surfaces, vowels as expressing their forms, *l* as expressing the liquid motion of these objects, and *r* as expressing their motion when interrupted.

That this principle has not only operated in the formation of all languages, but that, when it has operated without check or controul, the most beautiful and impressive effects have resulted from it, a very few examples and observations will clearly demonstrate.

* The observations which I have made respecting the five orders of vocal sounds, are applicable to the sounds emitted by musical instruments. None of them, in which solid parts are not brought into contact, produce consonants; and and those which produce vowels, correspond in the apertures by which they produce them to those which I have described. Thus, in vibrating chords, small or tense strings produce slender sounds, by a slender aperture between the two extremes of vibration; and large or loose ones, the reverse. Wind instruments, also, having circular apertures, alone produce the sound *o*; and those consisting of long tubes, as the organ, produce chiefly *u*.

I have, for instance, stated, respecting the perfect vowels, that they, thus, naturally express the forms of objects; and certainly the illustrations which I have already given of the manner of their production by the various forms of the organ of voice, by variously formed external objects, and by the various instruments of music, amply confirms the idea; viewed, however, in their simple and uncombined state, their power is not nigh so great, nor their effects so impressive, as when viewed in connexion. Yet, their increased power, when in connexion, is the best test of the value of this general principle.

Let us, therefore, choose one or two of these sounds—the *i* and the *o*, for example, and let us try their effect when heard in connexion with one or two sounds of a different order—the *l* and the *r*, for example, by which we shall see whether the effect which, according to the above principles, each has singly, is increased in combination, and whether consequently the theory be thereby confirmed.

Now, according to these principles, the *i* designating a point, and the *l* and *r* designating liquid aud interrupted motion, the *i* n connexion with the *l* ought to designate a minute body in liquid motion, and in connexion with *r* it ought to designate a minute body in interrupted motion. Accordingly the sound *li* is exactly that which a minute body in liquid motion produces, and the sound *ri* is also that which a minute body in interrupted motion produces. Consistently with these facts, were some of the most beautiful and impressive words, even of the English language, originally constructed; for, when a minute portion of the tongue glides in liquid or uninterrupted motion along the palate, the sound *li* is produced; and, in English, it is very appropriately and beautifully said 'to lisp;' and when, on the other hand, the point of any hard substance is carried in interrupted motion along the surface of another, the sound *ri* is produced, and, in English, it is with equal appropriateness and beauty said 'to rip or risp.'

Accordingly, also, to these principles, the *o* designating something spherical and larger, and the *l* and *r*, these two species of motion, the *o* in connexion with the *l* ought to designate a round body in liquid motion, and in connexion with *r*, it ought to designate a round body in interrupted motion. Accordingly the sound *lo* is exactly that which a spherical body in liquid motion produces, and the sound *ro* is also that which a spherical body in interrupted motion produces. Consistently, too, with these facts, were some of the most beautiful and impressive words even of the English language ori-

ginally constructed; for, when a rounder and larger body glides in liquid or uninterrupted motion, the sound *lo* is produced, and, in English, the body is, appropriately and beautifully, said to 'loll;' and when, on the other hand, a round body passes in interrupted motion along a rugged surface, the sound *ro* is produced, and, in English, the body is, with equal appropriateness and beauty, said 'to roll.'

Numerous words, in our language, of equal beauty and impression, are similarly constructed.

In English, Li indicates the liquid motion of a minute body in Libation, Lick, Lid, Life, Light, Lightning, Limpid, Line, Lineage, Liniment, Linguist, Lint, Lip, Liquid, Lisp, Literal, Lithe, Little, Live, or in the reversed arrangement of these sounds in Fill, Pill, Quill, Eel, &c. . . . Ri indicates the interrupted motion of a minute body in Riddle, Ride, Ridge, Rill, Rifle, Rip, Ripple, Risk, Rive, Rivet, Writ, Writing, Wriggle, &c. . . . Lo indicates the liquid motion of a rounder body in Lock, Loll, Look, Lop, Loquacity, Lot, Lotion, Lottery, Lounger, Lout, &c. . . . Ro indicates the interrupted motion of a rounder body in Roam, Roar, Rocker, Rock, Rocket, Roll, Romp, Rondeau, Rondel, Rope, Ropy, Rotary, Rote, Rotation, Rotundity, Rove, Rough, Round, Rout, Row, Rower, &c.

Foreign languages equally abound with words which are beautiful and impressive, precisely because constructed upon one and the same natural principle.

In French, Li indicates the liquid motion of a minute body in Liant, Lier, Lierre, Ligne, Lime, Lin, Lipe, Liqueur, Liquide, Lisse, Lisser, Lissure, &c. . . . Ri indicates the interrupted motion of a minute body in Ride, Rider, Rime, Rimer, Rinser, Rire, Ris, Risque, River, Rivet, &c. . . . Lo indicates the liquid motion of a rounder body in Lorger, Lorgneur, Lot, Lotir, &c. . . . Ro indicates the interrupted motion of a rounder body in Rôder, Rogonner, Rôle, Rond, Rondeau, Rondeur, Roquette, Rote, Rouage, Roue, Rouer, Rouet, Roulage, Roulant, Rouleau, Roulement, Roulette, Rouler, Roulier, Roulis, &c.

In Italian, Li indicates the liquid motion of a minute body in Libazione, Libare, Lieve, Ligame, Ligare, Lima, Limbiccare, Linea, Lineare, Lingua, Lino, Liquefare, Liquido, Liquore, Liscezza, Lisciare, Litterale, &c. . . . Ri indicates the interrupted motion of a minute body in Riccio, Ridda, Rifluire, Rigoro, Rigridare, Rio, Ripa, Riso. . . . Lo indicates the liquid motion of a rounder body in Locuzione, Logico, Loquela, Loquace, Lotto, &c. . . . Ro indicates the interrupt-

ed motion of a rounder body in Rocca, Roccetto, Rocchetto, Roco, Rombare, Rombo, Romore, Rompere, Rompitore, Ronda, Rouzamento, Rota, Rotala, Rotamento, Rotare, Rotazione, Rotolare, Rotolo, Rotondare, Rotondo, Rotta, Rottura, Rovina, Rovinare, Rozzo, &c.

In Spanish, Li indicates the liquid motion of a minute body in Lia, Liadura, Libacion, Libar, Licion, Licor, Liga, Ligadura, Ligar, Ligeramente, Ligero, Ligula, Limar, Limadura, Linage, Linea, Linear, Lino, Liña, Liquacion, Liquar, Liquidamente, Liquido, Liquor, Lisar, Lisamente, Liso, Listo, Lisura, Literal, Livianamente, Liviano, Lixa, Lixar, &c. . . . Ri indicates the interrupted motion of a minute body in Riço, Riçar, Riepto, Rio, Ripio, Risa, Risco, &c. . . . Lo indicates the liquid motion of a rounder body in Llover, Llovido, Loquaz, Loquasidad, &c. . . . Ro indicates the interrupted motion of a rounder body in Rodada, Rodado, Rodador, Rodadura, Rodante, Rodar, Rodillo, Rollo, Rollon, Romper, Rompido, Roncar, Roncadura, Ronco, Ronda, Rondo, Rota, &c.

In Portuguese, Li indicates the liquid motion of a minute body in Liar, Liado, Libar, Libaçam, Licor, Lido, Lima, Lingoa, Linha, Linho, Liquido, Liso, &c. . . . Ri indicates the interrupted motion of a minute body in Ribeyrinho, Ribeiro, Rifa, Rimula, Rio, Ripar, Ripio, Rir, Risa, Risca, Riscar, Riscadura, Risco, Rispido, Rispidamente, &c. . . . Lo indicates the liquid motion of a rounder body in Logico, Loquaz, Loquela, &c. . . . Ro indicates the interrupted motion of a rounder body in Ro, Roçado, Roda, Rodante, Rodar, Rodeo, Rol, Rolar, Rolda, Roldana, Rolham, Rolho, Ronco, Roncar, Rosca, Rota, &c.

In Latin, Li indicates the liquid motion of a minute body in Libatio, Licium, Ligo, Limo, Linea, Lingua, Linum, Liquidus, Liquor, Litera, &c. . . . Ri indicates the interrupted motion of a minute body in Rictus, Rima, Rivus, Rixa, &c. . . . Lo indicates the liquid motion of a rounder body in Locutio, Loquor, Loquela, Lotium, &c. . . . Ro indicates the interrupted motion of a rounder body in Rota, Roto, Rotundo, Ruo, &c.

In Greek, Λι indicates the liquid motion of a minute body in Λιβὰς, gutta; Λίγα, ſtridulè; Λιγαίνω, vocis acutum edo ſonum; Λίγδα, pulvis; Λίγδην, leviter; Λιγνὺς, flamma; Λιγὺς, ſonorus; Λιγύφθογγος, ſuavem vocem habens; Λιγύφωνος, argutus; Λιθάζω, lapido; Λιθὰς, lapillus; Λιθοβολέω, lapido; Λίκιγξ, exiliſſima avis vox; Λίνον, filium lincum; Λὶς, ſubtile linteum; Λισσὸς, lævis; Λιχμάζω, lingo; Λὶψ, petra, undè aqua ſtillat, &c. . . . Ρι indicates the interrupted motion of a minute body in Ῥιπὴ, impetus ejus quod projici-

tur; Ῥιπίζω, ventilo; Ῥίπτω, projicio; Ῥὶψ, vimen flexile, &c.... Λο indicates the liquid motion of a rounder body in Λόγιος, eloquens; Λογικὸς, idem; Λογος, verbum, oratio; Λοιβὴ, libatio; Λοέω, lavo; Λάω, idem; Λόχος, agmen; Λοχὸς, puerpera, &c.... Ῥο indicates the interrupted motion of a rounder body in Ῥόθος, undarum ſtrepitus; Ῥοικὸς, qui fluxione laborat; Ῥόμβος, turbo, impetus; Ῥόος, fluxus; Ῥόχθος, fluctuum ſtrepitus; Ῥοχθέω, ſonum edo; Ῥόω, ruo, &c.

Thus, in ſpoken, as in written language, all nations originally attempted one and the same natural method of deſignation, and wherever they ſucceeded in it, they rendered their reſpective languages highly expreſſive and intereſting. I may again point it out, as eminently worthy of remark, that, while all nations were, thus, in the early ages, following the obvious dictates of nature in endeavouring to expreſs objects and their actions by ſounds, or other ſigns, naturally allied to them—while they were attempting to conſtruct a natural ſpoken, acted or written language, they had all one and the ſame object in view, and had they perſevered, all would have attained that one object, the ſame language, differing only as nature differs, would have obtained in every nation under heaven, and all the people of the earth might have held unpremeditated, yet perfectly intelligible communication.... But inſtead of one fixed and definite language, we have now many vague and indefinite. Such has been the inexpreſſible loſs attending the abandonment of natural and the adoption of arbitrary ſigns.

From all this, then, it follows, that vocal ſounds reſembling thoſe which exiſt externally and which, or the objects emiting them are intended to be deſignated, alone can conſtitute a ſpoken natural language, becauſe they only can repreſent them, and again give the impreſſions and deſignate and re-excite the ideas, emotions or paſſions which thoſe ſounds or the objects emiting them originally excited.

OBJECTION.

If to theſe ideas, emotions and paſſions which were originally derived from peculiar ſounds being deſignated and re-excited in a Natural Language by vowels, conſonants and liquids, reſembling thoſe ſounds which originally excited them, it were ridiculouſly objected that, in order to ſpeak expreſſively in ſuch a Language it would be neceſſary a perſon ſhould, for inſtance, mew like a cat, grunt like a hog, chirp like a ſparrow, quack like a duck, croak like a frog, hum like a bee, &c.

ANSWER.

To this it must be answered that such objections confirm, instead of overturning the principle, because the words mew, grunt, chirp, quack, croak, hum, &c. however ridiculous they may appear in combination, are some of the most expressive and valuable words in the English language, for no other reason than that they very accurately resemble the sounds produced by the above mentioned animals, and are therefore founded on that very principle of natural language to which the objection is made.

The persons then who make such objections understand not the nature of the very words they use.

But were it objected, must a person, in order to speak expressively in such a language, roar like the sea in describing the noise which it produces? (and I believe the human organs of speech will appear much less capable of this than of any of the sounds mentioned above), even to this objection I should answer yes, if he will roar (to use the words of the objection) as Racine does in the most beautiful line of his Athalie; 'Celui qui met un frein à la *fureur de flots*' or as Homer does in one of the best written lines of his Iliad, where speaking of the 'sea of many waves,' he, in two last words of the line expresses admirably well both its roaring and that repeated dash which usually follows it, thus: 'Βη δακεων παραθινα πολυφλοισβοιο θαλλασσης.' Homer then, though he thought not of any such universal rule in the fundamental structure of language would have applauded the opinion which such persons pretend to condemn.

Having thus concluded what I have at present to say respecting the 1st or elementary part of language, I proceed to the 2d, or the nature of the words which these elements form.

II. DIVISION. OF THE CLASSES OF WORDS WHICH THESE ELEMENTS FORM.

Words then, I may now observe, whether naturally or arbitrarily constructed, have been reduced by Mr Tooke, in his invaluable ΕΠΕΑ ΠΤΕΡΟΕΝΤΑ or Diversions of Purley, to two kinds—Nouns and Verbs. The precise and invariable nature of these two classes of words does not, however, yet appear to be clearly defined. The attempt to determine their difference has led me to a most important observation, viz. that *nouns and verbs do not differ from each other more than either of them does*

from the other parts of speech, or, that ALL THE PARTS OF SPEECH ARE REDUCIBLE TO THE NOUN.

Nouns express all possible existences, qualities and relations, and all the other parts of speech merely express some of these existences, qualities and relations under peculiar circumstances; or, in other words, whenever the signs of any natural series of these existences, qualities and relations are brought together, though still nouns in their intimate nature, they change their appearance in order to indicate not only these simple existences, &c. but the particular relations which, in their present combination, they bear to each other.

Sometimes these relations are indicated by a mere change of termination as

addition	*adding*	*added*	*adds*	*and*
gift	*giving*	*given*	*gives*	*if*

Here *addition* and *gift* are nouns; *adding* and *giving*, adjectives or pres. part.; *added* and *given*, participles; *adds* and *gives*, verbs; *and* and *if*, conjunctions. Strictly speaking, however, they are all nouns, and differ from each other only in expressing the particular relations which, when in combination, they bear to those words with which they are connected. Thus *addition* and *gift* are simple nouns which require little illustration; *adding* and *giving* are the forms which these nouns receive when rendered subordinate to other objects which are present, whence they are called adjectives or present participles; *added* and *given* are the forms which they receive when subordinate to past objects, whence they are called past participles; *adds* and *gives* are the forms which they receive when they bear a relation to a preceding and succeeding object, the one of which acts upon or influences the other, and both of which must either be expressed or understood *; *and* and *if* are the forms which they receive when they bear a relation to less intimately connected preceding and succeeding objects, and the one of which does not necessarily act upon the other.

Sometimes nouns express these peculiar relations in which they stand not by any change of termination, but by signs prefixed to them as *a walk*, *to walk*.

Sometimes also they neither change their termination, nor have any sign prefixed, but their peculiar relation to other nouns is pointed out by their situation, as '*walking* is a &c.' and 'a man *walking*, &c.'

* Thus in saying *I give*, the *I* precedes, and *the object given* is understood to follow.

That the noun alone expresses something intrinsic, and that the rest, including the verb, refer to something extrinsic may be seen in the following manner. In the sentence '*The smooth ball rolling from him to this elevated point stops instantly and remains,*' the nouns *ball* and *point* alone indicate any thing intrinsic and independent, and express no relation to any other object; for, the word 'ball' designates that of which every point of its circumference is at the same distance from its centre, and the word 'point' here merely designates a minute object; but all the other words refer to something relative and external: The article *the* distinguishes this ball from others, and therefore expresses an external relation; the adjective *smooth* expresses its relation to the sense of touch; the present participle *rolling* expresses its relation to the general space on which it is; the prepositions *from* and *to* express the relation of its motion to certain objects, as commencing at one and terminating at the other; the pronoun *him* has a relation to an object not expressed, and is, therefore, termed relative; the word *this* (improperly termed a pronoun) expresses the relation of distance between the object to which it refers and the speaker; the past participle *elevated* expresses the relation which the point bears to contiguous objects; the verb *stops* contains a necessary relation both to the object which stops and to the place where it does stop; the adverb *instantly* expresses the relation, with regard to time, which this motion has to others; the conjunction *and* has likewise a relation both to a preceding and succeeding consideration—'stops' and 'remains,' but these are not, like the verb, necessarily connected *.

Thus, as seen above, the same noun, with the same unvaried sign, expresses different relations (and may have different names given to it) by mere change of place—an additional proof that *all words, fundamentally considered, are nouns, and that they differ in appearance merely in order to indicate, not any thing intrinsic but extrinsic*, viz. *the external relations which these various forms, intrinsically the same, may have to other nouns in connexion with which they may be placed.* THUS, THEREFORE, THERE IS ONLY ONE CLASS OF WORDS—NOUNS STRICTLY SO CALLED, WHICH REFER TO THE INTIMATE OR INTRINSIC NATURE OF THE OBJECTS WHICH THEY DESIGNATE. ALL THE REST, VERBS AS

* It is truly remarkable, that the authors of elementary books, who pretend to simplify this department of various languages, seem not only unacquainted with the real nature of the various parts of speech, but destitute of simple and natural arrangement. I sometime ago observed this circumstance to a very excellent teacher Mr J. P. Gassiot, who has just now produced a series of grammars of the principal modern languages, so admirably simple that they will form a most important acquisition both to the student and proficient.

WELL AS OTHERS, ARE MERE CHANGES WHICH THEY UNDERGO IN ORDER TO EXPRESS NEW AND VARIOUS EXTRINSIC RELATIONS.

It by no means, however, follows that because all these are fundamentally the same, therefore the terms expressing their different forms are to be abandoned. They are, on the contrary, of the utmost value. Though the simple idea, which a whole series of these forms indicate, be the same, yet they express its different relations, and wherever a new relation is discovered in expression, a new, though complex idea, is acquired.

It is of importance to us, for instance, to know, that we can combine the two nouns 'virtue' and 'man,' and that we cannot combine the nouns 'virtue' and 'vice.' This entirely arises from the two former words having, and the two latter not having any relation to each other. The various forms of words are, therefore, valuable in so far as they express these relations, because wherever a new relation is discovered in expression a new and necessarily complex idea is acquired, and though they do not express any thing intrinsic, they express something extrinsic with which it is equally important that we should be acquainted.

As, also, they express something additional or relative, as well as the mere idea with which they are connected, so they are worthy of those changes of termination which they possess and of the distinguishing names bestowed upon them. Thus when we see the line '*The glory of Europe has departed for ever*,' we have not only the simpler ideas connected with *glory*, *Europe*, *departure*, *eternity*, *&c.*, but we have the complex idea resulting from the particular forms which the above combination contains, and which, moreover, we could not possibly derive from the simpler signs themselves. The distinction, therefore, of nouns into subordinate classes is of absolute necessity and great value.

I am, however, of opinion that the more these forms are indicated, not by change of termination, but by detached signs, the more simple and perfect in this respect is the language. To this circumstance, the English owes much of its superiority to other languages.

It is, perhaps, worthy of observation, that in dictionaries, &c. all these words ought also to be distinguished as signs of objects, sensations, ideas, emotions, passions, &c.

III. DIVISION OF COMPOSITION, OR THE MODE OF CONNECTING THESE WORDS.

With regard to the 3d and last part of language—composition, its universal and exclusive principle is stated and illustrated both in the preceding volumes and in this. That principle is, 'that natural composition must always be strictly in the order of cause and effect; or, that objects must be designated successively as they give impressions to the organs of sense, and ideas, emotions and passions as they are excited or generated in the mind.' Its detailed illustration will be found in the volumes referred to.

SUBDIVISIONS OF THE GENERAL RULE.

Subordinate to, and resulting from this rule, are the observations, 1st, that, in composition, '*time*' should always be mentioned first, and consequently before 'place,' because time involves all events, whereas the existence of a city, town or village is a particular and transitory event; 2dly, that '*place*' should follow 'time' and precede the other 'general circumstances' of any story, because these circumstances are modified by the time and place; 3dly, that these '*general circumstances*' should immediately follow 'place' and precede the relation of the 'particular event,' because that event is especially modified by these circumstances; 4thly, that, in the event, the '*person*' or '*persons*' acting should be mentioned first, i. e. immediately after the 'general circumstances' and before their particular 'motives' or the 'conditions' of the action, because the person is primarily influenced by these circumstances; 5thly, that the '*motive*' should be mentioned immediately after the 'person' and before the 'act' itself, because the motive and condition are immediately dependent on the person; 6thly, that the '*act itself*' should be mentioned immediately after the 'motive' or 'condition' and before its 'result,' because the motive or condition directly induces the action; and, 7thly, that the '*result*' should be mentioned last *.

Example in Illustration of them.

According to these rules, the following sentence is correct. '(TIME) In the year 1809, (PLACE) on the banks of the Da-

* In the majority of European languages, I may also observe, adjectives are very properly arranged after substantives.

nube, (GEN. CIRC.) while the majority of the German states were under the influence of France, (PERSONS) the Archduke Charles, with a brave Austrian army, (MOTIVE) excited by the resolution to liberate their country or to fall in the attempt, (ACT) completely routed a powerful host of French marauders, foiled the renown of its ruffian chiefs, (RESULT) and gave an example to Europe which will ultimately be imitated.'

From this view of these important subdivisions of the general rule, may be seen how much is necessarily involved by the simple words 'cause and effect' in which that rule is expressed.

Conclusion.

It is worthy of remark, that by a strict adherence to this rule of composition, punctuation becomes less frequently necessary, because a more intimate connexion is, by means of it, effected between all the portions of a sentence. The slightest trial applied even to the best writers will prove this. The common maxim, therefore 'learn to punctuate' ought almost to be reversed; it ought to be, 'learn to write so that punctuation shall be as rarely as possible necessary.'

It is still more worthy of remark that, though it is generally said to be impossible for one person to write well in a variety of languages, yet by careful attention to this rule, any one acquainted with the mere words and the most general principles of many languages, will be enabled to write well in all of them.

This natural and universal rule of composition relatively to all languages is only to be avoided, when, from the natural imperfection of these languages, it brings together very discordant words, which scarcely ever occurs; &c.

With regard to a natural and universal system, it must, moreover, be observed that the principles upon which I have constructed this sketch, and upon which, if ever an entire system were formed, it also must be constructed, are obviously simple as the elements of nature itself; and the language formed on these principles would consequently re-excite in the mind, ideas as definite and emotions as strong as those excited by those objects which that language would designate. These principles indeed existing throughout all nature, and *being, in reality, those on which all the operations of the human mind depend*, it would obviously be, by natural and intrinsic powers, capable of exciting ideas, and of being intuitively understood by every one possessed of human feelings. Thus its study and practice

would be incomparably more easy than could at first be imagined.

Supposing, however, that mankind never should resume that general subject, but view these considerations solely as illustrating the construction of existing languages, it cannot fail to become eminently interesting, and it is with this last view alone that I have drawn up the present paper, and in that view that I wish it to be considered.

LITERARY COMPOSITION.

PRINCIPLE OF COMPOSITION, ENUNCIATED AND ILLUSTRATED IN THE PRECEDING VOLUMES, APPLIED TO THE GREEK LANGUAGE, AND TO POETICAL COMPOSITION.

BY THE EDITOR.

In the first Volume of the Archives, I delivered an Universally applicable Law of Literary Composition; and introduced in illustration of it examples from the works of our most celebrated orators, Fox, Pitt, Grattan, Curran and Mackintosh. In the second, I shewed it to be equally applicable to the Latin and to the chief of the modern European languages, the examples of its applicability to these various languages, being drawn from the highest sources,—from Junius and Burke, Voltaire and Rousseau, Machiavelli and Soave, Islas and Solis, Cæsar and Cicero. I shall now show it to be equally applicable to the Greek language, by means of examples from Xenophon and Demosthenes, and to Poetical Composition, by means of others from Shakespeare and Milton.

I am not unaware either of the difficulty or of the importance of the task which I have now to perform. When, in an especial manner, I approach the language of the sages—the orators—the heroes of Greece, I feel all the reverence which

I should do if I approached a personification of the genius which it expresses. It is not, therefore, without a sentiment almost approaching to devotion, that I presume to point out in it some trivial errors of composition—errors, however, which I am anxious to state, do not deviate more from natural construction than from the general habit of that divine language, and even from the frequent practice of the very writers in whose stile they exist.

EXAMPLES FROM THE GREEK.

XENOPHON.

In the examples from this admirable writer, I shall limit myself even to the first page of his Anabasis. There is probably no greater deviation from the rule of natural construction than that of expressing the motive of an action, which naturally precedes it, after that action to which it gives origin. Even in this page, there are two errors of this kind.

" Παρύσαλις," says Xenophon, " μὲν δὴ μήτηρ ὑπῆρχε τῷ Κύρῳ, φιλοῦσα αὐτὸν μᾶλλον, ἢ τὸν βασιλεύοντα Ἀρταξέρξην."

Now here 'the love of Parysatis for Cyrus,' which induced her to favour or support him, is incorrectly expressed after that 'act' to which it gave origin, and the cause is thereby put in the place of the effect.

It might have been thus expressed " Παρύσαλις μὲν δὴ μήτηρ, φιλοῦσα τὸν Κῦρον μᾶλλον, ἢ τὸν βασιλεύοντα Ἀρταξέρξην, ὑπῆρχε τῷ προτερῷ·

In the same paragraph, he also says " παρῄγγειλε τοῖς Φρυγίαρχοις ἑκάστοις λαμβάνειν ἄνδρας Πελοποννησίους, ὅτι πλείστους καὶ βελτίστους, ὡς ἐπιβουλεύοντι Τισσαφέρνει ταῖς πόλεσι."

Here also 'the motive or pretence,' that Tissaphernes had a design upon those cities, is most incorrectly placed after that 'act' which was pretended to be founded upon it.

It also might have been thus expressed " ὡς ἐπιβουλεύοντι Τισσαφέρνει ταῖς πόλεσι, παρήγγειλε, &c."

Now even Xenophon's own practice, and that too in the same paragraph, confirms what I now state. For, in the following expressions of this paragraph, he contradicts the practice which I have reprobated above, and correctly expresses first that circumstance which naturally precedes— " ἐξαιτησαμένη αὐτὸν, ἀποπέμπει πάλιν ἐπὶ τὴν ἀρχήν" "—ὑπολαβὼν τοὺς φεύγοντας, συλλέξας στράτευμα, ἐπολιόρκει Μίλητον." He does the same in several others, and thus himself presents us with the very fairest proof of the inaccuracy of the previous expressions.

It is proper, however, that I should remark, that some, in further examining the same paragraph, may conceive another mode of expression there used to be equally faulty with the example given above. Xenophon, for instance, says, "συλλάμβανει Κῦρον, ὡς ἀποκτενῶν." Now the word "ἀποκτενῶν" might here be supposed to indicate a motive, and therefore to be incorrectly placed after the word "συλλάμβανει," expressing an act. But this is not really the case. "Συλλάμβανει Κῦρον" does express the act, and "ὡς ἀποκτενῶν" expresses here, not a *motive* which induced, and which consequently ought to have been expressed before it, but the *purpose* to which that act is to be converted, and which consequently is most correctly placed after it.

I may also observe, that there is even a case in which the motive of an action is correctly expressed after it. That is, when the motive is not clearly understood, and is not positively mentioned as inducing the action, but when a historian endeavours, from the various circumstances of an action, to deduce the motive which excited it. And this, I may further observe, is strictly conformable to the natural rule of composition; for here both the act and motive are not to be considered with relation to him who acts. The act alone is to be considered in relation to him, and that certainly as an effect of which the cause is not obvious to us; but in relation to the historian, *the act* is to be considered as a cause, and the *assignment of the motive* as an effect—an inference which *he* deduces from it, and without which it could have no existence in his mind. In this case, therefore, it is properly placed last. But in all other cases, to place it last, is a violation of natural order, and of the rule of composition.

DEMOSTHENES.

I now approach one who, as an orator, has no rival, and who, had he, in defence of freedom, been as well prepared to resist the energies of body, as of mind—had his devotion to his country excited and maintained in him as much of military virtue, as of soul commanding eloquence, would have had no parallel on the face of the earth. In as far, however, as it is more noble and glorious to command the minds than the bodies of men, so far is the character of Demosthenes elevated even above that of the patriot hero—how incomparably higher above the fortunate usurper or the successful marauder. When within the influence of his eloquence, I feel a deference

which neither the one nor the other could inspire. It is with the utmost humility, then, that I presume to point out a few errors in composition in the productions of a being, the grandeur of whose genius was incapable of descending to objects comparatively trivial, and the fire of whose eloquence gave illumination and splendour to objects or rather expressions otherwise deformed.

In the few criticisms I shall make, I shall confine myself entirely to the commencement of the first Phillipic.

" Ὡς δὲ νῦν ἔχετε," says Demosthenes, " ἐδὲ διδόντων ὑμῖν τῶν καιρῶν Ἀμφίπολιν, δέξασθαι δύναισθ' ἄν, ἀπηρτημένοι καὶ ταῖς παρασκευαῖς, καὶ ταῖς γνώμαις."

Now here the rule of natural construction is violated by placing the cause, viz. the suspense of their designs and councils, after the effect which would result from it, viz. their inability to take possession of Amphipolis.

It ought to have been expressed thus: " Ὡς δὲ νῦν ἔχετε, ἀπηρτημένοι καὶ ταῖς παρασκευαῖς, καὶ ταῖς γνώμαις, ἐδὲ διδόντων ὑμῖν τῶν καιρῶν Ἀμφίπολιν, δέξασθαι δύναισθ' ἄν."

Again he says, " ἀλλὰ καὶ μισεῖ τις ἐκεῖνον, καὶ δέδιεν, ὦ ἄνδρες Ἀθηναῖοι, καὶ φθονεῖ, καὶ τῶν πάνυ νῦν δοκούντων οἰκείως ἔχειν αὐτῷ."

Here the effect is placed before the cause, and the rule of construction is violated, by placing ' the persons who act' after the ' action' which they perform.

It might have been written thus: " ὦ ἄνδρες Ἀθηναῖοι, καὶ τῶν πάνυ νῦν δοκούντων οἰκείως ἔχειν αὐτῷ, καὶ μισεῖ τις ἐκεῖνον, καὶ δέδιεν, καὶ φθονεῖ.

Again he also says, " καὶ τὰ ὑμέτερ' αὐτῶν κομιεῖσθε, ἂν θεὸς ἐθέλῃ, καὶ τὰ κατερραθυμημένα πάλιν ἀναλήψεσθε, κἀκεῖνον τιμωρήσεσθε."

Now here the rule of natural construction is grossly violated by placing ' the recovery of their dominions,' before ' the recalling of those previously neglected opportunities' which must have been the means of that recovery.

It ought obviously to have been arranged thus: " καὶ τὰ κατερραθυμημένα πάλιν ἀναλήψεσθε, κἀκεῖνον τιμωρήσεσθε, ἂν θεὸς ἐθέλῃ, καὶ τὰ ὑμέτερ' αὐτῶν κομιεῖσθε."

Now the practice of Demosthenes also confirms what I have just stated. In the following expressions, he also contradicts the practice which I have reprobated above, and correctly expresses first the cause and then the effect " —Καὶ γάρ τοι, ταύτῃ χρησάμενος τῇ γνώμῃ, πάντα κατέσραπται καὶ ἔχει;"—" εἰ γὰρ ἐκ τοῦ παρεληλυθότος χρόνου, τὰ δέοντα ἅπαντ' ἐβουλεύσαντο, οὐδὲν ἂν ὑμᾶς νῦν ἔδει βουλεύεσθαι." He also does the same in several others, and thus himself presents us with the very fairest proof of the inaccuracy of the previous expressions.

POETICAL COMPOSITION.

I AM perfectly aware that poetical composition has always, and that with some justice, been permitted an exemption from the rules to which prose is subject. I am aware, too, that this privilege is still more necessary to rhyme than to blank verse. With rhyme, therefore, I shall not in the the present paper interfere, but shall turn my attention entirely to the more natural and elevated species of poetry.

Even in this species of poetry, however, I shall not consider all those modes of expression erroneous, which in prose I should be apt to think so, but shall merely point out a few of those which do not interfere with poetical license, and which seem to me to be of a kind which might easily have been remedied by the poet. I shall presume even to correct any such error, and attempt, in a very inferior way, that which the poet himself could best have effected; but I trust, that if, in doing so, I illustrate and inforce the general principle, I shall be excused any slight error of poetical measure.

MILTON.

In the few observations which I shall make on the compositon of this great poet, I shall confine myself to the first book of Paradise Lost. There, the poet says of Satan,

> " ——Nor ever thence
> Had ris'n or heav'd his head, but that the will
> And high permission of all-ruling heaven
> Left him at large to his own dark designs,
> That with reiterated crimes he might
> Heap on himself damnation, while he sought
> Evil to others, and enraged might see," &c.

Now here the poet has unnecessarily deviated from natural construction in mentioning the conduct of Satan in the expressions, 'That with reiterated crimes he might heap on himself damnation,' before the circumstance *under* which that conduct took place, namely, 'While he sought evil to others,' and which ought consequently to have been mentioned first. For it is evident, that it was Satan's 'seeking evil to others' that constituted his conduct 'criminal,' and it was again by this criminality, that he was supposed to heap on himself dam-

nation.' If, therefore, arrangement have any use or meaning in composition, his act of 'seeking evil to others' ought to have been mentioned first; next the 'reiterated crimes' to which this act led; and, lastly, the 'damnation,' which was their consequence. Perhaps it ought to have been written thus:

"———Nor ever thence
Had ris'n or heav'd his head, but that the will
And high permission of all-ruling heaven
Left him at large to his own dark designs,
That, while contriving evil to others, *
With crimes reiterated, he might heap
Upon himself damnation, and enraged
Might see," &c.

Again he says,

"———But far within,
And in their own dimensions like themselves,
The great seraphic lords and cherubim
In close recess and secret conclave sat
A thousand demigods on golden seats,
Frequent and full,' &c.

Now here the poet deviates from the rule of natural construction. After mentioning 'these personages' in the third line, and 'their act' in the fourth, he most incorrectly recurs, in the fifth, to 'their number and situation'—two circumstances which ought obviously to have been stated in connexion with the persons, and before the act which they performed. It ought to have been arranged thus:

"———But far within,
And in their own dimensions like themselves,
The great seraphic lords and cherubim,
A thousand demigods on golden seats,
In close recess, and secret conclave sat
Frequent and full," &c.

Again he also says,

"———So thick bestrown
Abject and lost lay these, covering the flood,
Under amazement of their hideous change."

Here the poet deviates from the rule of natural construction in mentioning, in the third line, the slight emotion of 'amazement,' after stating in the second that they were 'abject

* I have used a little freedom with this line on account of the measure.

and lost, and after, moreover, concluding his simile at the end of the second line, in the words ‘ covering the flood.’ As this is the very conclusion of the simile, so it ought to have been the last expression of it. Thus,

> “ ———So thick bestrown,
> Under amazement of their hideous change,
> Abject and lost lay these, covering the flood.”

Again he likewise says,

> “ Which oft-times may succeed, so as perhaps
> Shall grieve him, if I fail not, and disturb
> His inmost counsels from their destin’d aim.”

Here the poet violates the natural rule of construction by expressing the act, in the words, ‘ shall grieve him,’ before the condition ‘ if I fail not,’ upon which that act must have depended ; or, rather, the words of the very first line imply the condition and the reintroduction of it in the words, ‘ if I fail not,’ is only an awkward repetition of it which ought not at all to have existed.

Still again he says,

> “ ———But he his wonted pride
> Soon recollecting, with high words, that bore
> Semblance of worth not substance, gently rais’d
> Their fainting courage, and dispell’d their fears.”

Here the rule is violated by the ‘ raising of courage’ being mentioned before the ‘ dispelling of fear—a most preposterous arrangement. It is evident that fear must be entirely and thoroughly dispelled before the very slightest degree of courage can exist. It might perhaps have been thus expressed:

> “ ———But he his wonted pride
> Soon recollecting, with high words, that bore
> Semblance of worth not substance, soon dispell’d
> Their fears, and gently rais’d their fainting courage.’

Sometimes, however, it is admissible in poetry to deviate slightly from natural order, by introducing *time*, for instance, after the act which was performed in it. But this is never the case unless, along with the time, some other dependent circumstances are introduced, which altogether would have formed too long a statement to precede the action, &c. Thus Milton is less to be blamed when he says,

" ———He it was, whose guile,
Stirr'd up with envy and revenge, deceiv'd
The mother of mankind, *what time* his pride
Had cast him out from heav'n with all his host
Of rebel angels, by whose aid aspiring
To set himself in glory 'bove his peers,
He trusted to have equall'd the Most High,
If he oppos'd; and with ambitious aim
Against the throne and monarchy of God
Rais'd impious war in heav'n, and battle proud,
With vain attempt."

Or when he says,

" His legions, angel forms, who lay entranc'd
Thick as autumnal leaves that strow the brooks
In Valombrosa, where th' Etrurian shades
High over-arch'd imbow'r; or scatter'd sedge
Afloat, when with fierce winds Orion arm'd
Hath vex'd the red-sea coast, whose waves o'erthrew
Busiris and his Memphian chivalry,
While with perfidious hatred they pursued
The sojourners from Goshen, who beheld
From the safe shore their floating carcases
And broken chariot-wheels: so thick bestrown," &c.

Still this, however, has a laboured appearance, and is not perfectly natural.

But even Milton's frequent practice is decidedly in my favour, and against himself, in the above quoted deviations from natural order. When he says,

" Th' imperial ensign, which full high advanc'd
Shone like a meteor streaming to the wind,"

he correctly expresses the 'situation' of the object before its 'appearance.' When he says,

" We may, with more successful hope, resolve,"

he beautifully identifies the 'resolution' with that 'hope' which accompanies it, by placing the latter between the two verbs, 'may' and 'resolve.' When he says,

" That with sad overthrow and foul defeat
Hath lost us heav'n,"

he correctly places the cause before the effect. When he says,

" To *wage*, by *force or guile*, eternal war," and
" To *work* in close design, by *fraud or guile*,"

he as correctly expresses the particular means after the general act.

His most beautiful passages too are precisely those in which he fortunately wrote in most conformity to the principle, as

" ——Him the almighty Power
Hurl'd headlong *flaming* from th' etherial sky,
With hideous ruin and *combustion*, *down*
To *bottomless perdition*, there to *dwell*
In adamantine *chains* and *penal fire*,
Who durst defy th' Omnipotent to arms:' * and

' He *spake ;* and to *confirm* his words, *out flew*
Millions of flaming *swords*, drawn from the thighs
Of mighty cherubim ; the sudden *blaze*
Far round *illumin'd* hell : highly they *rag'd*
Against the high'st, and fierce with grasped arms
Clash'd on their sounding shields the din of war,
Hurling defiance to'ward the vault of heav'n."

Thus Milton himself affords the most irresistible confirmation of the truth of the principle.

SHAKESPEARE.

In making some similar remarks upon this immortal dramatist, I shall confine myself to his Othello ; and, in doing so, shall first point out those errors which are of least importance, but which are still deviations from the principle.

* I cannot here avoid referring to a French translation of this beautiful passage by Le Marquis de Saint Simon, not for the purpose of criticism, but of showing the vast superiority of the English Language. Although the translator calls his attempt ' Essai de Traduction *Energique*,' yet it is weak, contemptible, ludicrous. ' Le Tout-puissant le précipita du haut des cieux, tout en flammes, et dans le plus affreux désastre jusques dans l'abîme de perdition : c'est là, que doit demeurer dans les chaines de diamant, au sein des feux vengeurs, qui osa défier le Tout-puissant aux armes.' Milton's genius elevated this ludicrous subject by language which was solemn, grand, energetic, irresistibly commanding ; and the Marquis Saint Simon, in his most serious attempt, turns it into travestie. . . It is not, however, the fault of the Marquis, but of the language in which he writes—a language which, not the ingenuity, but the intrigues of its writers have contrived to spread over Europe, and which we owe much to Lord Grenville for having banished from all our diplomatic transactions. This last is an object of the utmost importance ; for he who often talks the language of that people will inevitably be tainted with their weakness, just as men become imbecille by keeping the company of fools. It would be of as great importance to Britain to spread her language over Europe as her conquests over the ocean.

" If," says the Poet, " e'er my will did trespass, 'gainst
his love,
Either in discourse, or thought, or actual deed," &c.

Now here the words 'discourse' 'thought' and 'actual deed' are unnecessarily so arranged as to violate natural order. 'Thought' ought obviously to be first, 'discourse' next, and 'actual deed, last; thus

" If e'er my will did trespass 'gainst his love,
Either in thought, discourse, or actual deed."

Again he says,

" Witness that here Iago doth give up
The execution of his wit, hands, heart,
To wrong'd Othello's service."

Here similarly the words 'wit' 'hands' 'heart' are arranged so as to violate natural order. The word 'heart' ought to have been placed first, because it is the feelings commonly attributed to it which are supposed first to excite to acts of friendship; 'wit 'next, because it is the business of genius to invent the means of accomplishing the purpose, and 'hands' last because they put it in practice; thus

" Witness that here Iago doth give up
The execution of his heart, wit, hands,
To wrong'd Othello's service."

Again he says,

" For I'll refer me to all things of sense,
If she in chains of magic were not bound,
Whether a maid—so tender, fair, and happy,
So opposite to marriage, that she shun'd
The wealthy curled darlings of our nation—
Would ever have, to incur a general mock,
Run from her guardage to the sooty bottom
Of such a thing as thou."

Now here natural composition is violated by the *particular condition* 'If she in chains of magic were not bound' being placed before the *general circumstances* 'Whether a maid—so tender, &c.' In consequence of this also, the first and third lines are unnaturally separated by the intervention of the second. It ought perhaps to have been arranged thus,

" For I'll refer me to all things of sense,
Whether a maid—so tender, fair, and happy,

So opposite to marriage, that she shun'd
The wealthy curled darlings of our nation,—
If she in chains of magic were not bound,
Would ever have to incur a general mock,
Run from her guardage to the sooty bottom
Of such a thing as thou."

Again the Poet says,

"I should make very forges of my cheeks,
That would to cinders burn up modesty,
Did I but speek thy deed."

Natural composition is here entirely violated by expressing the 'effect' before the 'cause' on which it is supposed to depend. It should have been

"——Did I but speak thy deed,
I should make very forges of my cheeks
That would to cinders burn up modesty."

Again he says,

"——I had rather be a toad,
And live upon the vapour of a dungeon,
Than keep a corner in the thing I love,
For others' uses."

Natural composition is here violated by not mentioning that first which he is to reject for an alternative; for it is evident that that which he is to refuse ought to be mentioned first, and, as it were, thrown aside, and that which he is to chuse ought to be mentioned last, and, as it were, taken in lieu of the former. The passage ought therefore to be expressed thus,

"Rather than keep a corner in the thing
I love, for others' uses, I'd be a toad,
And live upon the vapour of a dungeon."

But it is of little use to dwell on these details: their tendency must already be sufficiently obvious. I may, however, observe that there is no species of poetry which seems at first sight to present so many deviations from this rule as the dramatic. This, however, is merely in appearance; for there are in reality none which present so few, and the mistake arises entirely from the student neglecting, that often it is not external physical objects, but the succession of ideas which is described. The fine passage of this drama after the death of Desdemona might seem at first sight contradictory to it; but it is in reality most perfectly consistent with it, and affords an admirable instance of the beauty which an adherence to the latter part of

the rule—'that ideas, emotions and passions should be expressed as they are excited and generated in the mind,' invariably produces. It is

"*Oth.* Yes;—'tis Æmilia:——by and by.——She's dead.
'Tis like she comes to speak of Cassio's death;
The noise was high.——Ha! no more moving?
Still as the grave.——Shall she come in? Were't good?
I think, she stirs again:——No.——What's the best
If she come in, she'll sure speak to my wife:——
My wife! my wife! what wife? I have no wife.
O insupportable! O heavy hour!"

This is indeed admirably constructed, and in perfect consistency with the principle. No other poet has produced any thing equal to it. The

"Quos ego: sed motas præstat componere fluctus,"

of Virgil is stiff, cold, absolutely contemptible when compared with it; and the

"Fillan and Ryno—but he is not here! My son rests on the bed of death,"

of Ossian, though much better than that of Virgil, for it is more simple and natural, is yet immeasurably below the aposiopesis of Shakespeare.

The rule is also admirably adhered to in this passage:

"——O my soul's joy!
If after every tempest come such calmness,
May the winds blow 'till they have waken'd death!
And *let* the lab'ring bark climb hills of seas
Olympus high; and duck again as low
As hell's from heaven!"

Thus Shakespeare himself also affords the most irresistible confirmation of the truth of the principle.

FINE ARTS.

CRITIQUE ON THE ANTIQUE STATUES AND THOSE OF MICHAEL ANGELO; IN WHICH NOT ONLY THE DEFECTS OF THEIR ATTITUDES, BUT ALSO THE ERRORS WHICH THEY PRESENT WITH REGARD TO THE PARTICULAR MUSCLES BROUGHT INTO ACTION ARE POINTED OUT.

BY THE EDITOR.

In order to render the following criticisms intelligible, I must here repeat a few of the preliminary observations which I made on this subject in the last volume of the Archives.

All the fine arts result from the muscular motions of the body, and they may be divided into two classes, according as they depend upon the motions of the body in general, or only upon those of the organ of voice in particular. Thus the more chastened species of Dancing (*Gesture*, it may be termed, for the former name has been degraded), *Sculpture*, and the higher species of *Painting* form the FIRST CLASS; *Spoken Language*, (for it may justly be termed a fine art), *Poetry*, and *Music* form the SECOND.

Of the first class, viz. those depending on the motions of the body in general, Gesture is evidently the first, for it not only involves the motions of the body, but actually consists in their performance; Sculpture is the second, for it most closely approaches to the real attitudes of gesture; and the higher species of Painting is the third, because it is next in the reality of form, and, though inferior to sculpture in this respect, it far excells it in others. Of the second class, viz. those depending on the motions of the organ of voice, Spoken Language is the first, because it involves the most distinct articulation—the proper basis of all intelligible sound, and is besides

unfettered, and at liberty to assume much of the harmony of poetry or of music; Poetry is the second, because it superadds to spoken language, the quality last alluded to, but, in other respects, becomes more fettered than it; and Music is the third, because it enjoys this quality in a still greater degree, but unfortunately abandons articulation—the basis of language.

As, then, all the fine arts implicitly depend upon the muscular motion of the human body, and as those of the first class actually consist in its evident performance, it is fortunate that one or at furthest two general rules express the chief circumstances in them which are referable to it.

THE SIMPLE PRINCIPLE OF ELEGANT CONTRAST IN ATTITUDE AND MOTION IS, THAT WHILE EITHER OF THE EXTREMITIES OF ONE SIDE IS ADVANCED, BOTH THOSE OF THE OTHER MUST BE WITHDRAWN, AND WHEN EITHER OF THE EXTREMITIES OF ONE SIDE IS ELEVATED, THE CORRESPONDING ONE OF THE OTHER MUST BE DEPRESSED.

The contrast which takes place according to this principle is more especially between the upper extremities of opposite sides, and between the lower extremities of opposite sides, not between the upper of one and the lower of the other side. For, on the contrary, between the last mentioned extremities a species of harmony exists. When the arm of one side is raised, the leg of the other is to be correspondingly elevated, and when the arm of one side is carried before the head, the leg of the opposite side is to be thrown behind its fellow; and although the movement in one is forward and in the other backward, yet they perfectly correspond, because the greater number of the articulations of the upper extremity have an anterior aspect, and those of the lower a posterior one—the one extremity as naturally bends backward as the other forward, and therefore, though the names of these motions differ, yet they are perfectly suitable to the consentaneous elevation of the opposite arm and leg, and their corresponding extension is perfectly suitable to their consentaneous depression. *Thus the consentaneous elevation and inflexion, and the depression and extension of the opposite arm and leg afford a principle of harmonic attitude and movement as beautiful as that of contrast already mentioned.*

THE SIMPLE PRINCIPLE, THEN, OF HARMONY IN ATTITUDE AND MOTION IS, THAT THE UPPER EXTREMITY OF ONE SIDE AND THE LOWER OF THE OTHER MUST BE ELEVATED AND INFLECTED, AND DEPRESSED AND EXTENDED TOGETHER.

But although these principles are very generally applicable, they are not without exceptions. It is obvious, that to the common acts of life, they are not intended to apply,—the

mechanic must regulate the motion and attitudes of his limbs, not by any theory of ideal beauty, but by the form of the machinery which he must actuate, or of which he may almost be said to form a portion. It is also obvious, that in some of the superior circumstances of life, as in the preaching of St Paul, alluded to by Sir Joshua Reynolds, a formal, stiff and ungraceful attitude is far more correct than the most graceful ideal one, because it is more natural to the person who uses it, and consequently more likely to interest those who are concerned in it.

All this, however, forms no real objection to the general rules just delivered. They are rules which the orator, the sculptor and the painter ought ever to have in view. It is as proper to the saint in prayer equally to elevate the arms to heaven, as it is to the mechanic to throw out his elbows in a peculiar direction; both of these are the acts of their peculiar employments; both of them are correct and becoming in their situation; but neither of them afford either exception or objection to the principles of ideal elegance and grace.

Having, thus, in the previous volume, given an arrangement of the fine arts, and stated the general principles which prevail in the first class, I, in that paper, made a few remarks on the application of these principles to the first of the class—gesture. I now, therefore, proceed to apply them to the second and third—sculpture and painting.

In my paper upon this subject in the last volume of the Archives, I neglected to mention an important fact, viz. that when the leg and arm of one side are elevated together, the equipoise of the body is lost; one side of the figure seems to be firmly supported, and the other to be, as it were, hanging by it; and in consequence of the leg of the fixed side being straight, and the arm of the same side pendent, the whole of that side seems motionless, and the whole of the other in action; the figure appears to have one half alive and the other dead, or rather one half paralytic and the other in convulsions. The loss of equipoise may be remedied, by twisting the trunk of the body to the side on which the arm is pendent, and of which the leg is straight; but the awkwardness will thereby be increased. There, however, remains no mode of remedying the unequal distribution of motion.

I am sorry that these remarks are applicable to many even of the ancient statues, and to almost all the modern. The fabricators of the former had exquisite taste, but no principle to direct them; those of the latter, seem to have very little either of the one or of the other.

As the first part of the volume is already much enlarged, I must limit my present observations to a few of these admirable productions, and consider even them as briefly as possible.

THE LAOCOON

Is one of the most perfect and admirable remains of antiquity, whether it be considered with regard to the general attitude or the particular muscles which are brought into action.

In the former of these circumstances, moreover, it coincides in a more than usual degree with the principle I have laid down. It may be remarked, that, though both the lower extremities are bent, yet it is the right which is chiefly under the line of the body, and outward from this, in a straight form, the left leg is thrown. Consistently with this, the right arm is thrown most outward from the body—is elevated and rendered straightest, while, in order to correspond with the right knee, which is most under the line of the body and bent, the left arm is closest to the body and bent also. The whole of the left side, too, may be considered as being most advanced, and the right, as most withdrawn, were it not that the right leg is somewhat advanced and the trunk slightly twisted, owing to the peculiar circumstances of the figure. The whole, however, is of as pure ideal correctness as it possibly could be considering what these circumstances are, and affords an admirable example of the slight degree in which it is necessary to depart from ideal purity even in order to express very peculiar circumstances.

With regard to the particular muscles supposed to be in action, there are, however, one or two errors. The biceps cubiti, for instance, of the right arm, which is employed in thrusting from him a fold of the serpent, is more enlarged than a flexor could be during the act of extension. The biceps of the left arm, which is similarly employed, has the same fault, and the latissimus dorsi of that side is also similarly blameable. Both of the great pectoral muscles, moreover, are supposed to be in comparably greater action than is consistent with both arms being carried slightly backward.

THE GLADIATOR.

Of this fine figure, the attitude has given origin to considerable dispute, and it remains yet undetermined what its object is. It certainly was not intended to represent a Gladiator, since it is neither in the attitude of attack nor of defence. It has been named the Gladiator Repellent; but its attitude is such as to be incapable of resistance; and it is worthy of remark that it is so, precisely because it is conformable to the rules which have been termed academic *, and at utter variance with the principles which I have delivered—that is, because the left leg is thrown backward and the left arm at the same time forward. In my previous paper, upon this subject, I observed, that this was the attitude of walking, and by no means of ideal expression where, if introduced, it would constitute not contrast, but contortion; and contortion it always does effect, when the rules termed academic are followed; accordingly this figure has rather the appearance of running—a circumstance, which, in spite of attachment to academic rules, some could not help noticing. Their explication, however, is quite insufficient. In running, the posterior leg is never so straight, nor the anterior one so much bent, nor the trunk thrown so directly forward as they are in the gladiator. Considered, therefore, in any point of view, I am afraid, it must be deemed a most serious error of the sculptor. . . Perhaps, however, it is the attitude of one, not running, but gently and quietly escaping, by moving on the tiptoe, and, at the same time, holding himself as much on the defensive as is consistent with the act of progression. Yet this is scarcely the subject which a Grecian sculptor would have chosen.

With regard to the particular muscles supposed to be in action, the lower part of the abdominales of the left side is too prominent, and, on the back of the figure, there exists in excess an error which many antique figures present, namely, that the inferior margin of the trapezius is too prominent. The deltoides also of the elevated arm is perhaps not quite prominent enough, and the pectoralis and more especially the latissimus dorsi of that side are too much so. The muscles likewise drawing the right arm backward are too weak, especially the latissimus dorsi, which ought here to have been prominent, and, at the fore and upper part of the right thigh, there are some elevations, which there are there no muscles that could

* See the paper on this subject in the 2d vol. of Archives.

cause, and which its mere bent position could not possibly occasion.

THE DANCING FAUN.

Respecting the propriety of the general attitude of this figure, it is somewhat difficult to determine. There is much aukwardness in the attitude, in consequence of the leg and arm of one side being elevated together. This aukwardness also is increased by the body, being, in order to counteract the last circumstance, bent to the opposite side. But the figure is not of that pure ideal kind which would entitle us to expect in it an exemption from vulgar and untutored habits. Hence, it is possible, that the artist, though skilled in correct ideal attitude, deliberately abandoned it, and adopted one the aukwardness of which he imagined more perfectly to coincide with the natural character of the subject. Indeed I am convinced, that this really was the motive of the artist; and the deviation from the principle, in the present case, consequently affords an admirable illustration of the value of it in all cases. For, unless the principle be understood, it is neither possible correctly to apply it in forms purely ideal, nor to determine how far, in other instances, peculiar habits demand its abandonment.

With regard to the muscles brought into action in this figure, there are several errors. In particular, the deltoides of the elevated arm is not in action quite so strong as the position demands, while the pectoralis is obviously too much so; and the gastrocnemius and soleus of the elevated leg have the opposite fault; for though some of these last muscles are, in consequence of their connexion with the os femoris, employed in bending the knee, yet it is chiefly in extending the foot, that they are usually employed, nor are they ever powerfully employed in bending the knee when the foot is not, at the same time, extended, or when there is not a great force to overcome. Now, although the knee is bent in the present case, yet the foot is neither extended, nor is there any force to overcome; the muscles are therefore too much exerted.

THE VENUS DE MEDICI.

This is doubtless the most exquisitely beautiful remain of antiquity. The admirable form of the mammæ, whence man first learns ideal beauty, which, without being too large, oc-

cupy the bosom, rise from it with nearly equal curves on every side, and equally terminate in their apices; the flexile waist gently tapering little further than the middle of the trunk; the lower portion of it beginning gradually to swell out higher even than the umbilicus; the gradual expansion of the haunches, those voluptuous characteristics of the female, indicating at once her fitness for the office of generation and that of parturition—expansions which increase till they reach their greatest extent at the superior part of the thigh; the fullness behind their upper part and on each side of the lower part of the spine, commencing as high as the waist, and terminating in the still greater swell of the distinctly separated nates; the flat expanse between these and immediately over the fissure of the nates, relieved by a considerable dimple on each side and caused by the elevation of all the surrounding parts; the fine swell of the broad abdomen which, soon reaching its greatest height immediately under the navel, slopes gently to the mons veneris, but, narrow at its upper part, expands more widely as it descends, while, throughout, it is laterally distinguished by a gentle depression from the more muscular parts on the sides of the pelvis; the beautiful elevation of the mons veneris; the contiguous elevation of the thighs which, almost at their commencement, rise as high as it does; the admirable expansion of these bodies inward or toward each other by which they almost seem to intrude upon each other and to exclude them from their respective places; the general narrowness of the upper and the unembraceable expansion of the lower part thus exquisitely formed, 'whiter too than snow, and smooth as monumental alabaster'—all these admirable characteristics of female form, the mere existence of which in woman must, one would imagine, be, even to herself, a source of indescribable pleasure—these constitute a being worthy of occupying the temples of Greece; present an object finer, alas! than nature seems even capable of producing; and offer to all nations and ages a theme of admiration and delight*.

Of errors in this figure, I see none in the general attitude, and in muscular action none can exist; but the arms, of modern construction, are unworthy of the figure, having nothing feminine or beautiful in their form. There are two errors, however, even in the figure; first, the too strong depression or rather fold below the nates, and secondly, the form of the nates

* Some copies of this figure, and those of the largest size, are so execrably bad, that one is almost prompted to say, the copyist deserved punishment for his insensibility and gross stupidity.

themselves, which are far too little diffused, especially downward. The knees, lower parts of the legs and the ankles, also, are perhaps scarcely sufficiently slender.

HERCULES AND ANTEUS OF MICHAEL ANGELO.

The character of this God of Painters does not appear to have been correctly appreciated. It is neither the display of anatomical knowledge which his works present, nor the correctness of his design that chiefly characterizes this great master. It is the boldness, the grandeur, the sublimity of his genius which appear through his anatomy, in spite of its licentiousness, and through his designs, in spite of their incorrectness. Were I a painter or a sculptor, I should not hesitate to say, with Sir J. Reynolds, 'May the last words which I pronounce be the name of Michael Angelo.'

The first part of this volume has now increased so much, that at present, I must limit my observations to one of his productions—the group of Hercules and Anteus.

With regard to the attitudes of this group, there is a very gross error in that of the Hercules. His arms which invest and grasp Anteus, have the palmar side of the fore-arm and the palms themselves turned from the object which they grasp, and are thereby rendered utterly incapable of the force which they are supposed to exert. If Michael Angelo intended this to indicate the facility with which Hercules could effect this, it must then be considered as a piece of unpardonable extravagance, for, in the first place, no one, under similar circumstances, would naturally use his arms in such a manner; and, in the second, it is impossible for any one who knows the structure and uses of these parts to conceive arms of such strength as would render it possible to crush a giant by such a feeble attitude.

With regard to the particular muscles brought into action, there are errors equally great. As this is the first figure which I criticise of this great man's, I may here make the general observation, that his errors in this way are almost always physiological, never anatomical, that is, they always consist, not in giving improper forms or even improper places to the muscles, but in giving to them improper actions. In the present group, the general error of this kind is, that the extensors and flexors are throughout almost equally in motion—a circumstance which can take place only in convulsion. In the Hercules, the extensor cubiti of the right arm is in the most pow-

erful action—a circumstance which, instead of enabling him to grasp, would release Anteus. The inferior part of the abdominal muscles of the right side of the same figure are also thrown into extravagant action. In the Anteus, too, the rectus cruris of the right side, though its antagonists are supposed to enable the extremity to grasp the left side of Hercules, is put in the most powerful action—a circumstance which would absolutely undo the grasp. Even the left lower extremity of Anteus, which is pendent, has the muscles of the calf thrown into unnecessary and unnatural action. The bicipites flexores cubitorum of both arms of this figure are also put in the most powerful action, although these extremities are supposed to be employed in pushing from him the head and right shoulder of Hercules, and consequently the extensors ought alone to be employed.

HIGHGATE
Literary & Scientific
INSTITUTION

PATENT OFFICE LIBRARY

FIFTH DEPARTMENT OF SCIENCE, OR MORALS.

MORAL SCIENCE IN GENERAL.

ANALYSIS OF THE MORAL SYSTEM OF MR GODWIN *, WITH CRITICAL OBSERVATIONS.

BY THE EDITOR.

Introductory Observations.

As the general tendency and some of the particular doctrines of the important work which I have now to analyse, have been entirely misunderstood by some, who are perhaps not much in the habit of reflecting, it is the duty of the Editor, who is desirous of adapting this work to all classes of readers, to remove even their error if possible. I shall, therefore state two or three of the chief instances in which this misconception has occurred, and shall obviate them in the language of Mr Godwin himself; for it is a truth, that a careful perusal of the work would have entirely obviated them.

1st, As to Mr Godwin's undervaluing the private affections in the earlier editions of his work on political justice, it was amply and publicly obviated by the following statement: †

* Inquiry concerning Political Justice, and its Influence on Morals and Happiness. By William Godwin. 3d Edition. London, 1798.

† Preface to St Leon.

'Some readers of my graver productions will perhaps, in perusing these little volumes, accuse me of inconsistency; the affections and charities of private life being every where in this publication a topic of the warmest eulogium, while in the enquiry concerning political justice they seemed to be treated with no indulgence and favour. In answer to this objection, all I think it necessary to say on the present occasion is, that, for more than four years, I have been anxious for opportunity and leisure to modify some of the earlier chapters of that work in conformity to the sentiments inculcated in this. Not that I see cause to make any change respecting the principle of justice, or any thing else fundamental to the system there delivered; but that I apprehend domestic and private affections inseparable from the nature of man, and from what may be styled the culture of the heart, and am fully persuaded that they are not incompatible with a profound and active sense of justice in the mind of him that cherishes them. The way in which these seemingly jarring principles may be reconciled, is in part pointed out in a little book which I gave to the public in the year 1798, and which I will here, therefore, take the liberty to quote.' "A sound morality requires that nothing human should be regarded by us as indifferent; but it is impossible we should not feel the strongest interest for those persons whom we know most intimately, and whose welfare and sympathies are united to our own. True wisdom will recommend to us individual attachments; for with them our minds are more thoroughly maintained in activity and life than they can be under the privation of them, and it is better that man should be a living being, than a stock or a stone. True virtue will sanction this recommendation; since it is the object of virtue to produce happiness, and since the man who lives in the midst of domestic relations, will have many opportunities of conferring pleasure, minute in the detail, yet not trivial in the amount, without interfering with the purposes of general benevolence. Nay, by kindling his sensibility, and harmonising his soul, they may be expected, if he is endowed with a liberal and manly spirit, to render him more prompt in the service of strangers and the public." . . . On this important subject, no explanation can be more ample or explicit.

2dly, As to his observations on cohabitation and marriage, they absolutely require no explanation: they were delivered as a mere philosophical speculation—put even in the form of a question—and, if ever applicable, to be applied only in a more perfect and far distant society, when univer-

sal knowledge may render vice more repulsive, virtue more attractive, and political restraint less necessary. In this way, neither the bigot of superstition nor of politics would scruple to speculate, and it would be most unjust to accuse the philosopher for doing so.

3dly, As to the general tendency of the work, which has also been mistaken by some, Mr Godwin, in the preface to the second edition of it, observes, 'The Enquiry concerning Political Justice has been treated by some persons as of a seditious and inflammatory nature. This is probably an aspersion. If the political principles in favour of which it is written have no solid foundation, they have little chance to obtain more than a temporary fashion; and the present work is ill calculated to answer a temporary purpose. If, on the contrary, they be founded in immutable truth, it is highly probable, to say the least, that they will one day gain a decisive ascendency. In that case, the tendency of such a disquisition, will be to smooth the gradation, and to prepare the enlightened to sympathise with the just claims of the oppressed and the humble. No man can more fervently deprecate scenes of commotion and tumult, than the author of this book; no man would more anxiously avoid the lending his assistance, in the most distant manner, to animosity and bloodshed; but he persuades himself that, whatever may be the events with which the present crisis of human history shall be distinguished, the effect of his writings, as far as they are in any degree remembered, will be found favourable to the increase and preservation of general kindness and benevolence.' On the particular subject of revolution, also, Mr Godwin expressly says, 'Revolution is engendered by an indignation against tyranny, yet is itself evermore pregnant with tyranny.—Revolution is instigated by a horror against tyranny, yet its own tyranny is not without peculiar aggravation.—Revolutions, instead of being truly beneficial to mankind, answer no other purpose, than that of marring the salutary and uninterrupted progress, which might be expected to attend upon political truth and social improvement. They disturb the harmony of intellectual nature. They propose to give us something, for which we are not prepared, and which we cannot effectually use. *They suspend the wholesome advancement of science, and confound the progress of nature and reason*'... Yet this is the man who was, at the moment of publishing this, accused of love to revolutionary principles, by artful intriguers and fawning sycophants—by men whose

wavering and uncertain conduct has proved them destitute of all principle.

I have never, I believe, permitted myself to be influenced either by the motives or by the outcry of such persons. Of little importance as my opinion may be, I feel a pleasure in throwing myself in opposition to such unreasonable conduct. I have no hesitation in declaring the Enquiry concerning Political Justice to be, in my opinion, by far the most valuable work on the fundamental parts of moral and political science which has ever been presented to the world.

After this candid declaration, I am convinced I shall not not be blamed by the author of that work, if throughout the following analysis, I rigidly criticise whatever appears to me to be obvious to criticism. I may, in some points, be mistaken, but I am most anxious to avoid it.

As the arrangement of Mr Godwin appears to me to be in many points incorrect, I shall, in the following analysis, entirely disregard it, and adopt that which seems to me to be a more natural one—an arrangement conformable to the general system of science which I have adopted. My arrangement, therefore, necessarily brings together parts, which appear to me to be in the original work incorrectly disjoined, and separates parts which in it appear to have no relation to each other: Throughout, also, I deliver no more of the system than seems to me either to be original, or necessary to connect those doctrines which are so.

Under the present Department of the Archives, I ought to consider that part of the work only which belongs to moral science, but as Mr Godwin has blended with it certain doctrines relative to the mind—or physiological doctrines, which are yet too brief to be placed alone under the Department of Particular Physics, I shall consider them here, prefixing them to those which properly belong to Moral Science.

By thus abandoning the arrangement of the author, something I am aware will be lost, but I believe more will be gained by the clearer view which will be obtained of the natural relations which exist between the portions of science which are to be considered.

ANALYSIS OF THE MORAL SYSTEM, &c.

1. OF THE MECHANISM OF THE HUMAN MIND.

1. The theory of the human mind is properly, like the theory of every other series of events with which we are acquainted, a system of mechanism; understanding by mechanism nothing more, than a regular succession of phenomena, without any uncertainty of event, so that every consequent requires a specific antecedent, and could be no otherwise in any respect than as the antecedent determined it to be.

2. But there are two sorts of mechanism capable of being applied to the solution of this case, one which has for its medium only matter and motion, the other which has for its medium thought.

3. There are various reasons calculated to persuade us that this last hypothesis is the most probable. No inconsiderable argument may be derived from the singular and important nature of that property of human beings which we term thought; which it is surely somewhat violent to strike out of our system as a mere superfluity. A second reason, still more decisive than the former, arises from the constancy with which thought, in innumerable instances, accompanies the functions of this mechanism.

4. In order to ascertain whether every thought be attended with consciousness, it may be proper to consider whether the mind can have more than one thought at any one time. Now this seems altogether contrary to the very nature of mind. In comparing two objects, we frequently endeavour, as it were, to draw them together in the mind, but we seem obliged to pass successively from the one to the other... But let us suppose a given mind to have two ideas at the same time; we have then two trains of thinking exactly contemporary in the same mind. Very curious questions will here arise. Have they any communication? Do they flow separately, or occasionally cross and interrupt each other? Can any reason be given, why one of them should not relate to the doctrine of fluxions, and the other to the drama? in other words, why the same man should not, at the same time, be both Newton and Shakespeare? Why may not one of these coexisting trains be of a joyful, and the other of a sorrowful tenour? There is no absurdity that may not be supported upon the assumption of this principle.

5. The first difficulty on this subject is that which arises from complex ideas. The mind, however, can apprehend only a single idea at once, but that idea needs not be a simple idea. There seems no sufficient reason to deny, that all those objects which are painted at once upon the retina of the eye, produce a joint and simultaneous impression upon the mind. But they are not immediately conceived by the mind as many, but as one... A second difficulty is of a much subtler nature. It consists in the seeming 'impossibility of performing any mental operation, such as comparison, for example, which has relation to two or more ideas, if we have not both ideas before us at once, if one of them be completely vanished and gone before the other begins to exist.' The source of this difficulty seems to lie in the mistake of supposing that there is a real interval between the two ideas. The instant that connects them is of no real magnitude, and produces no real division. The mind is always full. It is this instant, therefore, that is the true point of comparison.

6. Consciousness, as it has been above defined, appears to be one of the departments of memory. Now the nature of memory, so far as it relates to the subject of which we are treating, is obvious. Some thoughts may with great attention and effort be revived; others obtrude themselves uncalled for; and a third sort are perhaps out of the reach of any power of thought to reproduce, as having never left their traces behind them for a moment. If the memory be capable of so many variations and degrees of intensity, may there not be some cases with which it never connects itself? If the succession of thoughts be so inexpressibly rapid, may they not pass over some topics with so delicate a touch, as to elude the supplement of consciousness?

7. It seems to be consciousness, rather than the succession of ideas, that measures time to the mind. The succession of ideas is, in all cases, exceedingly rapid, and it is by no means clear that it can be accelerated. Indeed it is a contradiction in terms to suppose that the succession of thoughts, where there is nothing that perceptibly links them together, where they totally elude the memory and instantly vanish, can be a measure of time to the mind.

8. Thought may be the source of animal motion, and yet there may be no need of a distinct thought producing each individual motion. Out of these various impressions, the most powerful, or that which has the greatest advantage to solicit my attention, overcomes and drives out the rest; or, which not less frequently happens, some idea of association, sug-

gested by the last preceding idea, wholly withdraws my attention from every external object. It is probable, however, that this perception is imperceptibly modified by the miniature impressions which accompany it, just as we actually find that the very same ideas presented to a sick man take a peculiar tinge, which renders them exceedingly different from what they are in the mind of a man in health. After this manner, not only every perception is complicated by a variety of simultaneous impressions, but every idea that now offers itself to the mind, is modified by all the ideas that ever existed in it.

9. These remarks furnish us with an answer to the long disputed question, whether the mind always thinks? It appears that innumerable impressions are perpetually made upon our body; and the only way in which the slightest of these is prevented from conveying a distinct report to the mind, is in consequence of its being overpowered by some more considerable impression. From the explication above given, it appeared that not one of the impressions was really lost, but tended, though in a very limited degree, to modify the predominant impression. Accordingly, the fact of our awaking from sleep when we are called, shows us that every, the most minute, impression that is made upon our bodies in a state of sleep or deliquium, is conveyed to the mind, however faint may be its effect, or however it may be overpowered and swallowed up by other sensations or circumstances.

10. To apply these observations. If a number of impressions acting upon the mind, may come to us so blended as to make up one thought or perception, why may not one thought, in cases where the mind acts as a principle, produce a variety of motions?

11. The consequences, which seem deducible from this theory of mind, are sufficiently memorable. Hence it appears, that all those motions, which are observed to exist in substances having perception, and which are not to be discovered in substances of any other species, may reasonably be suspected to have thought, the distinguishing peculiarity of such substances, for their source. An example of one exists in the phenomenon of walking. Another class of motions of a still subtler nature, are the regular motions of the animal economy, such as the circulation of the blood, and the pulsation of the heart.

12. Motion in general may be distributed into four classes; the simpler motions, which result from what are called the essential properties of matter and the laws of impulse; the more complex ones, which cannot be accounted for by the assumption of these laws; such as gravitation, elasticity, electricity

and magnetism; the motions of the vegetable and of the animal systems. Each of these seems further than that which preceded it, from being accounted for by any thing we understand of the nature of matter.

OBSERVATIONS ON THE PRECEDING SECTION.

Although Mr Godwin has introduced this chapter of his work after many subjects both moral and political, yet as it belongs to neither of these subjects, being that branch of physiology which considers the functions of the intellectual organs, I have placed it first in the present analysis.

The distinction, asserted in the second paragraph, to exist between thought and motion, is in my opinion objectionable in the extreme. Thought seems to be completely identified with motion; it is in fact nothing more than the action of the intellectual organs; nor is the one of these in the least more mysterious than the other. This is clearly shown in the paper on the intellectual functions in the last volume of this work, and therefore need not be dwelt on here.

Hence the third paragraph also requires no answer.

In the fourth and fifth paragraphs, Mr Godwin appears not to distinguish ideas from perceptions. The latter are always considerably simple, and differ only from sensations in having reached the sensorium commune; ideas, on the contrary, are always more or less compound, as their very existence requires two or more perceptions. The general reasoning of the paragraph, however, seems to me to be correct, except where the author wishes to account for reasoning by the contact as it were of two trains of ideas. To me it would seem that this process is inexplicable by any other means than the impressions which two trains in their alternate passage through the mind inevitably *leave* on the substance of the organ, thereby blending, and permitting the comparison of their effects.

I cannot think that consciousness is, as seems implied in the sixth paragraph, ever absent from mental operations. Mr Godwin himself soon after endeavours to show that all impressions on the senses, in some degree or other, affect the mind, at least as modifying other impressions which more evidently affect it. Now consciousness is to the internal operations of this system precisely what sensation is to external affections of it. Hence it follows, that, like the latter, the former may be modified but cannot be entirely lost. Consciousness, indeed, seems to be a property inseparable from this system.

Though it be evident that no ideas or internal events but those of which we are conscious (and we can have none of which we are not conscious) can possibly be compared with the succession of external events, yet it is impossible that consciousness, considered as it is in the seventh paragraph, can in any way measure time to the mind. However variable in duration thoughts may be, they still afford a measure of time, and it is that very variability that renders them so very bad a measure of it.

That as observed in the eighth paragraph, a distinct thought is not necessary to the production of each individual motion cannot be doubted. 'Thought,' however, is perhaps too general a term to be used on the present occasion; idea' or rather 'perception' would have been a better one. For it is most probable that mental operations are complex precisely in proportion to the complexity of the impressions which excite them, and that they are always as complex as the locomotion which they induce.

As to the continuance of thought even during sleep, it seems to me to be unsupported. Susceptibility of impression and actual thought are very different, nor does the former by any means imply the latter. Sound sleep indeed appears to require the absolute cessation of all thought. That peculiar and unexpected sounds most readily awake one from sleep, arises entirely from this that the nervous system, then completely at rest, is most easily brought into new action by excitements different from those which last exhausted it.

The subject of the tenth paragraph has been already remarked on. Impression, sensation, thought and locomotion constitute a series of actions equally simple throughout. The motion cannot be more complex than the thought in which it arises, because it is, if I may use the term, merely that thought or action transmitted to the locomotive organs.

The subject of the eleventh paragraph is previously commented on, except that portion of it which reckons the action of the heart, &c. to be dependent on thought. The reverse of that is the truth: that action depends upon the excitement of the blood. The truth of this is indicated by the fewness and minuteness of the nerves supplying that organ. All facts and reasonings also prove that its actions are involuntary precisely because it derives its excitement, not from the organ of volition, but from the fluid it contains.

I know of no distinction of motion into classes as mentioned in the twelfth paragraph. All the motion with which I am acquainted is easily reducible to one kind.

II. THE CHARACTERS OF MEN ORIGINATE IN EXTERNAL CIRCUMSTANCES.

1. The actions and dispositions of men are not the offspring of any original bias that they bring into the world in favour of one sentiment or character rather than another, but flow entirely from the operation of circumstances and events acting upon a faculty of receiving sensible impressions.

2. [Here Mr Godwin clearly refutes the arguments from innate principles and from instinct.]

3. If then it appear that the human mind is unattended either with innate principles or instincts, there are only two remaining circumstances that can be imagined to anticipate the effects of institution, and fix the human character independently of every species of education: these are, the qualities that may be produced in the human mind previously to the era of our birth, and the differences that may result from the different structure of the greater or subtler elements of the animal frame. To objections derived from these sources the answer will be in both cases similar.

4. At the moment of birth man has really a certain character, and each man a character different from his fellows. The accidents which pass during the months of percipiency in the womb of the mother, produce a real effect. But ideas are to the mind nearly what atoms are to the body. The whole mass is in a perpetual flux; nothing is stable and permanent; after the lapse of a given period not a single particle probably remains the same. Who knows not that in the course of a human life the character of the individual frequently undergoes two or three revolutions of its fundamental stamina. He that considers human life with an attentive eye, will not fail to remark that there is scarcely such a thing in character and principles, as an irremediable error. If it is thus in habits apparently the most rooted, who will be disposed to lay any extraordinary stress upon the impressions which an infant may have received in the womb of its mother? If the early impressions of our childhood may by a skilful observer be as it were obliterated almost as soon as made, how much less can the confused and unpronounced impressions of the womb, be expected to resist the multiplicity of ideas that successively contribute to wear out their traces?. . . Education never can be equal. The inequality of external circumstances in two beings whose situations most nearly resemble, is so great as

to baffle all power of calculation. In the present state of mankind this is eminently the case. There is no fact more palpable, than that children of all sizes and forms indifferently become wise. It is sufficient to recollect the nature of moral causes to be satisfied that their efficiency is nearly unlimited. In fine, it is impression that makes the man, and, compared with the empire of impression, the mere differences of animal structure are inexpressibly unimportant and powerless.

5. Speak therefore the language of truth and reason to your child, and be under no apprehension for the result. Show him that what you recommend is valuable and desirable, and fear not but he will desire it. Convince his understanding, and you enlist all his powers animal and intellectual in your service. How long has the genius of education been disheartened and unnerved by the pretence that man is born all that it is possible for him to become? How long has the jargon imposed upon the world, which would persuade us that in instructing a man you do not add to, but unfold his stores? The miscarriages of education do not proceed from the boundedness of its powers, but from the mistakes with which it is accompanied. We often inspire disgust, where we mean to infuse desire. We are wrapped up in ourselves, and do not observe, as we ought, step by step, the sensations that pass in the mind of our hearer. We mistake compulsion for persuasion, and delude ourselves into the belief that despotism is the road to the heart. Multitudes will never exert the energy necessary to extraordinary success, till they shall dismiss the prejudices that fetter them, get rid of the chilling system of occult and inexplicable causes, and consider the human mind as an intelligent agent, guided by motives and prospects presented to the understanding, and not by causes of which we have no proper cognisance and can form no calculation. Industry will be exerted with tenfold alacrity, when it shall be generally confessed that there are no obstacles to our improvement, which do not yield to the powers of industry. Education will proceed with a firm step and with genuine lustre, when those who conduct it shall know what a vast field it embraces; when they shall be aware, that the effect, the question whether the pupil shall be a man of perseverance and enterprise or a stupid and inanimate dolt, depends upon the powers of those under whose direction he is placed, and the skill with which those powers shall be applied.

6. Apply these considerations to the subject of politics, also, and they will authorise us to infer, that the excellencies and defects of the human character, are not derived from cau-

ses beyond the reach of ingenuity to modify and correct. If we entertain false views and be involved in pernicious mistakes, this disadvantage is not the offspring of an irresistible destiny. We have been ignorant, we have been hasty, or we have been misled. Remove the causes of this ignorance or this miscalculation, and the effects will cease. Show me in the clearest and most unambiguous manner that a certain mode of proceeding is most reasonable in itself or most conducive to my interest, and I shall infallibly pursue that mode, as long as the views you suggested to me continue present to my mind. The conduct of human beings in every situation is governed, by the judgments they make and the sensations that are communicated to them.

7. It has appeared that the characters of men are determined in all their most essential circumstances by education. By education, in this place, I would be understood to convey the most comprehensive sense that can possibly be annexed to that word, including every incident that produces an idea in the mind, and can give birth to a train of reflections. It may be of use for a clearer understanding of the subject we here examine, to consider education under three heads; the education of accident, or those impressions we receive independently of any design on the part of the preceptor; education commonly so called, or the impressions which he intentionally communicates; and political education, or the modification our ideas receive from the form of government under which we live. In the course of this successive review, we shall be enabled in some degree to ascertain the respective influence which is to be attributed to each.

8. It is not unusual to hear persons dwell with emphasis on the wide difference of the results in two young persons who have been educated together; and this has been produced as a decisive argument in favour of the essential differences we are supposed to bring into the world with us. But this could scarcely have happened but from extreme inattention in the persons who have so argued. Innumerable ideas, or changes in the state of the percipient being, probably occur in every moment of time. How few of these enter into the plan of the preceptor! Two children walk out together. One busies himself in plucking flowers or running after butterflies, the other walks in the hand of their conductor. Two men view a picture. They never see it from the same point of view, and therefore strictly speaking never see the same picture. If they sit down to hear a lecture or any piece of instruction, they never sit down with the same degree of attention, seriousness or

good humour. The previous state of mind is different, and therefore the impression received cannot be the same. It has been found in the history of several eminent men, and probably would have been found much oftener, had their juvenile adventures been more accurately recorded, that the most trivial circumstance has sometimes furnished the original occasion of awakening the ardour of their minds and determining the bent of their studies.

9. It may however reasonably be suspected whether the education of design be not, intrinsically considered, more powerful than the education of accident. If at any time it appear impotent, this is probably owing to mistake in the project. The instructor continually fails in wisdom of contrivance, or conciliation of manner, or both. It may often happen, either from the pedantry of his habits, or the impatience of his temper, that his recommendation shall operate rather as an antidote than an attraction. Preceptors are apt to pique themselves upon disclosing part and concealing part of the truth, upon a sort of common place, cant exhortation to be addressed to youth, which it would be an insult to offer to the understandings of men. But children are not inclined to consider him entirely as their friend, whom they detect in an attempt to impose upon them. Were it otherwise, were we sufficiently frank and sufficiently skilful, did we apply ourselves to excite the sympathy of the young and to gain their confidence, it is not to be believed but that the systematical measures of the preceptor would have a decisive advantage over the desultory influence of accidental impression. Children are a sort of raw material put into our hands, a ductile and yielding substance, which, if we do not ultimately mould in conformity to our wishes, it is because we throw away the power committed to us, by the folly with which we are accustomed to exert it. But there is another error not less decisive. The object we choose is an improper one. Our labour is expended, not in teaching truth, but in teaching falsehood. When that is the case, education is necessarily and happily maimed of half its powers. The success of an attempt to mislead can never be complete. We continually communicate in spite of ourselves the materials of just reasoning; reason is the genuine exercise, and truth the native element of an intellectual nature; it is no wonder therefore, that, with a crude and abortive plan to govern his efforts, the preceptor is perpetually baffled, and the pupil, who has been thus stored with systematic delusions, and partial, obscure and disfigured truths, should come out any thing rather than that which his instructor intended him.

10. It remains to be considered what share political institution and forms of government occupy in the education of every human being. Their degree of influence depends upon two essential circumstances.

First, it is nearly impossible to oppose the education of the preceptor, and the education we derive from the forms of government under which we live, to each other; and therefore, however powerful the former of these may be, absolutely considered, it can never enter the lists with the latter upon equal terms. Should any one talk to us of rescuing a young person from the sinister influence of a corrupt government by the power of education, it will be fair to ask, who is the preceptor by whom this task is to be effected? Is he born in the ordinary mode of generation, or does he descend among us from the skies? Has his character been in no degree modified by that very influence he undertakes to counteract? It is beyond all controversy, that men who live in a state of equality, or that approaches equality, will be frank, ingenuous and intrepid in their carriage; while those who inhabit where a great disparity of ranks has prevailed, will be distinguished by coldness, irresoluteness, timidity and caution. Will the preceptor in question be altogether superior to these qualities? Which of us is there who utters his thoughts, in the fearless and explicit manner that true wisdom would prescribe? Who, that is sufficiently critical and severe, does not detect himself every hour in some act of falsehood or equivocation, that example and early habits have planted too deeply to be eradicated? But the question is not, what extraordinary persons can be found, who may shine illustrious exceptions to the prevailing degeneracy of their neighbours. As long as parents and teachers in general shall fall under the established rule, it is clear that politics and modes of government will educate and infect us all. They poison our minds, before we can resist, or so much as suspect their malignity. Like the barbarous directors of the Eastern seraglios, they deprive us of our virility, and fit us for their despicable employment from the cradle. So false is the opinion that has too generally prevailed, that politics is an affair with which ordinary men have little concern.

Secondly, supposing the preceptor had all the qualifications that can reasonably be imputed, let us recollect for a moment what are the influences with which he would have to struggle. Political institution, by the consequences with which it is pregnant, strongly suggests to every one who enters within its sphere, what is the path he should avoid, as well as what he should pursue. Under a government fundamentally erroneous,

he will see intrepid virtue proscribed, and a servile and corrupt spirit uniformly encouraged. But morality itself is nothing but a calculation of consequences. What strange confusion will the spectacle of that knavery which is universally practised through all the existing classes of society, produce in the mind? The preceptor cannot go out of the world, or prevent the intercourse of his pupil with human beings of a character different from his own. Attempts of this kind are generally unhappy, stamped with the impression of artifice, intolerance and usurpation. From earliest infancy therefore there will be two principles contending for empire, the peculiar and elevated system of the preceptor, and the groveling views of the great mass of mankind. These will generate confusion, uncertainty and irresolution. At no period of life will the effect correspond to what it would have been, if the community were virtuous and wise. But its effect, obscure and imperceptible for a time, may be expected to burst into explosion at the period of puberty. When the pupil first becomes master of his own actions, and chooses his avocations and his associates, he will necessarily be acquainted with many things of which before he had very slender notions. At this time the follies of the world wear their most alluring face. He can scarcely avoid imagining that he has hitherto laboured under some species of delusion. Delusion, when detected, causes him upon whom it was practised to be indignant and restive. The only chance which remains, is that, after a time, he should be recalled and awakened: and against this chance there are the progressive inticements of society; sensuality, ambition, sordid interest, false ridicule, and the incessant decay of that unblemished purity which attended him in his outset. The best that can be expected, is that he should return at last to sobriety and truth, with a mind debilitated and relaxed by repeated errors, and a moral constitution in which the seeds of degeneracy have been deeply and extensively sown.

OBSERVATIONS ON THE PRECEDING SECTION.

I have introduced the preceding section immediately after that on the mechanism of the mind, because, after considering that mechanism, it seems natural next to consider the mode in which it is actuated.

The whole section is one of the greatest excellence. I believe, however, that the effects of original structure are not

so easily obviated as Mr Godwin thinks. Children always resemble their parents as much in mind as in features, although from seeing them strongly in contrast with each other, we may sometimes be apt to imagine that there is little resemblance either in the one or in the other. Strangers to both, for this reason most readily discover the similarity. The insensible creature is rarely if ever changed into one of sensibility, or the timid into the courageous. Mr Godwin seems to overlook the immense differences which exist in the relative proportions of the various parts of the intellectual organs. In some, the organs of sense; in others, the cerebrum; and in others, the cerebellum is most developed, and the greatest difference in function results from these differences of proportion. *Impulse does not only modify mechanism, but is, in various manners turned aside and diverted by it.* The same stream may turn a flour and a paper mill, but they will never perform one operation, nor produce one effect. The other reasonings of the section are, however, unobjectionable.

III. THE VOLUNTARY ACTIONS OF MEN ORIGINATE IN THEIR OPINIONS.

1. There is a doctrine, the advocates of which have not been less numerous than those for innate principles and instincts, teaching "that the conduct of human beings in many important particulars is not determined upon any grounds of reasoning and comparison, but by immediate and irresistible impression, in defiance of the conclusions and conviction of the understanding. This if true, no less than the doctrine of innate principles, opposes a bar to the efforts of philanthropy, and the improvement of social institutions.

2. Now voluntary action is, where the event is foreseen previously to its occurrence, and the hope or fear of that event forms the excitement, or, as it is most frequently termed, the motive, inducing us, if hope be the passion, to endeavour to forward, and, if fear, to endeavour to prevent it. But, if every voluntary action be performed for the sake of its consequences, then in every voluntary action there is comparison and judgment. Hence, it appears that the voluntary actions of men in all cases originate in their opinions. Actions therefore which are preceded by a judgment "this is good," or "this is desirable," originate in the state of judgment or opinion upon that subject.

3. It may happen that the opinion may be exceedingly fugitive; it may have been preceded by aversion and followed by remorse; but it was unquestionably the opinion of the mind at the instant in which the action commenced. The persuasion that exists in the mind of the drunkard in committing his first act of intoxication, that in so doing he complies with the most cogent and irresistible reasons capable of being assigned upon the subject, may be exceedingly temporary; but it is the clear and unequivocal persuasion of his mind at the moment that he determines upon the action. The thoughts of the murderer will frequently be in a state of the most tempestuous fluctuation; he may make and unmake his diabolical purpose fifty times in an hour; his mind may be torn a thousand ways by terror and fury, malignity and remorse. But, whenever his resolution is formed, it is formed upon the suggestions of the rational faculty; and, when he ultimately works up his mind to the perpetration, he is then most strongly impressed with the superior recommendations of the conduct he pursues. One of the fallacies by which we are most frequently induced to a conduct which our habitual judgment disapproves, is that our attention becomes so engrossed by a particular view of the subject, as wholly to forget, for the moment, those considerations which at other times were accustomed to determine our opinion. In such cases, it frequently happens, that the neglected consideration recurs the instant the hurry of action has subsided, and we stand astonished at our own infatuation and folly.

4. In strictness however there is a third class of actions, which belongs neither to the voluntary nor involuntary, yet partakes of the nature of both. These, such as relate to our garments, our food, &c. &c. are only imperfectly voluntary. There are habits of a second sort. In proportion as our experience enlarges, the subjects of voluntary action become more numerous. In this state of the human being, he soon comes to perceive a considerable similarity between situation and situation. In consequence he feels inclined to abridge the process of deliberation, and to act to-day conformably to the determination of yesterday. Thus the understanding is not at the trouble continually to go back and revise the original reasons which determined it to a course of action. Thus the man acquires habits, from which it is very difficult to wean him, and which he obeys without being able to assign either to himself or others, any explicit reason for his proceeding. This is the history of prepossession and prejudice.

5. This sort of habit however must be admitted to retain something of the nature of voluntariness for two reasons. First,

it proceeds upon judgment, or apprehended motives, though the reasons of that judgment be out of sight and forgotten; at the time the individual performed the first action of the kind, his proceeding was perfectly voluntary. Secondly, the custom of language authorises us in denominating every action as in some degree voluntary, which a volition, foresight or apprehended motive in a contrary direction, might have prevented from taking place.

6. In the mean time it is obvious to remark, that the perfection of the human character consists in approaching as nearly as possible to the perfectly voluntary state. We ought to be upon all occasions prepared to render a reason of our actions. We should remove ourselves to the furthest distance from the state of mere inanimate machines, acted upon by causes of which they have no understanding. We should be cautious of thinking it a sufficient reason for an action, that we are accustomed to perform it, and that we once thought it right. The human understanding has so powerful a tendency to improvement, that it is more than probable that, in many instances, the arguments which once appeared to us sufficient, would upon re-examination appear inadequate and futile.

7. Now it should seem that the great practical principle remains as entire as ever. Still volition and foresight, in their strict and accurate construction, are inseparable. All the most important occasions of our lives, are capable of being subjected at pleasure to a decision, as nearly as possible, perfectly voluntary. Reason therefore and conviction still appear to be the proper instrument, and the sufficient instrument for regulating the actions of mankind.

8. It may be objected, by a person who should admit the force of the above arguments, "that it cannot be denied that the perturbations of sense frequently seduce the judgment, and that the ideas and temporary notions they produce, are too strong for any force that can be brought against them. But, what man is now in this respect, he will always to a certain degree remain. He will always have senses, and, in spite of all the attempts which can be made to mortify them, their pleasures will always be accompanied with irritation and allurement. Hence it appears, that all ideas of vast and extraordinary improvement in man are visionary, that he will always remain in some degree the dupe of illusion, and that reason, and absolute, impartial truth, can never hope to possess him entire."

9. The points already established tend in some degree to set this new question in a clearer light. From them it may

be inferred that the contending forces of reason and sense, in the power they exercise over our conduct, at least pass through the same medium, and assume the same form. It is opinion contending with opinion, and judgment with judgment; and this consideration is not unattended with encouragement. It follows therefore that, in the contention of sense and reason, it cannot be improbable to hope that the opinion which is intrinsically the best founded, shall ultimately prevail.

10. But let us examine a little minutely these pleasures of sense, the attractions of which are supposed to be so irresistible. In reality they are in no way enabled to maintain their hold upon us, but by means of the adscititious ornaments with which they are assiduously connected. Reduce them to their true nakedness, and they would be generally despised. Where almost is the man, who would sit down with impatient eagerness to the most splendid feast, the most exquisite viands and highly flavoured wines, "taste after taste upheld with kindliest change," if he must sit down alone, and it were not relieved and assisted by the more exalted charms of society, conversation and mutual benevolence? It is probable that he who should form himself with the greatest care upon a system of solitary sensualism, would come at last to a decision not very different from that which Epicurus is said to have adopted, in favour of fresh herbs and water from the spring.

11. "But let it be confessed that the pleasures of sense are unimportant and trivial. It is next to be asked, whether, trifling as they are, they may not nevertheless possess a delusive and treacherous power, by means of which they may often be enabled to overcome every opposition?"

12. The better to determine this question, let us suppose a man to be engaged in the progressive voluptuousness of the most sensual scene. Here, if ever, we may expect sensation to be triumphant. Passion is in this case in its full career. In this situation, nothing is so easy as to extinguish his sensuality! Tell him at this moment that his father is dead, that he has lost or gained a considerable sum of money, or even perhaps that his favourite horse is stolen from the meadow, and his whole passion shall be instantly annihilated: So vast is the power which a mere proposition possesses over the mind of man. Is it then to be supposed that the power of sensual allurement, which must be carefully kept alive, and which the slightest accident overthrows, can be invincible only to the artillery of reason, and that the most irresistible considerations of justice, interest and happiness, will never be able habitually to controul it?

13. To consider the subject in another point of view. It seems to be a strange absurdity, to hear men assert, that the attractions of sensual pleasure are irresistible, in contradiction to the multiplied experience of all ages and countries. Have not all the considerations which have power over our hopes, our fears, or our weaknesses, been, in competition with a firm and manly virtue, employed in vain? But what has been done, may be done again. What has been done by individuals, cannot be impossible, in a widely different state of society, to be done by the whole species.

14. It has been remarked, "that, as the human mind has no innate and original principles, so all the information it has, is derived from sensation. It is therefore reasonable to conclude, that the original substance should be most powerful in its properties, and the pleasures of external sense more genuine than any other pleasure. Thus, after all the complexities of philosophy, we are brought back to this simple and irresistible proposition, that man is an animal purely sensual. Hence it follows, that in all his transactions much must depend upon immediate impression, and little is to be attributed to the generalities of ratiocination."

15. But it does not follow from hence, that the pleasures of our external organs, are more exquisite than any other pleasures. It is by no means unexampled for the result of a combination of materials to be more excellent than the materials themselves. No man ever performed an act of exalted benevolence, without having sufficient reason to know, at least so long as the sensation was present to his mind, that all the gratifications of appetite are contemptible in the comparison.

16. The great advantage possessed by the allurements of sense is, "that the ideas suggested by them are definite and precise, while those which deal in generalities are apt to be faint and obscure. Add to which, that what is present forces itself upon our attention, while that which is absent, depends for its recurrence upon the capriciousness of memory."

17. But if my ideas of virtue, benevolence and justice, or whatever it is that ought to restrain me from an improper leaning to the pleasures of sense, be now less definite and precise, they may be gradually and unlimitedly improved.

18. It has been said, "that a rainy day will frequently convert a man of valour into a coward." If that should be the case, there is no presumption in affirming that his courage was produced by very slight and inadequate motives. Pain is probably more formidable in its attacks upon us, and more exquisitely felt than any species of bodily pleasure. Yet all

history affords us examples, where pain has been contemned and defied by the energies of intellectual resolution. Do we not read of Mutius Scævola who suffered his hand to be destroyed by fire without betraying any symptom of emotion, and archbishop Cranmer who endured the same trial two hundred years ago in our own country? Is it not recorded of Anaxarchus, that, while suffering the most excruciating tortures, he exclaimed, "Beat on, tyrant! Thou mayest destroy the shell of Anaxarchus, but thou canst not touch Anaxarchus himself?" The very savage Indians sing amidst the wanton tortures that are inflicted on them, and tauntingly provoke their tormentors to more ingenious cruelty. When we read such stories, we recognise in them the genuine characteristics of man. Man is not a vegetable to be governed by sensations of heat and cold, dryness and moisture. He is a reasonable creature, capable of perceiving what is eligible and right, of fixing indelibly certain principles upon his mind, and adhering inflexibly to the resolutions he has made.

19. The tendency of the whole is, to ascertain an important principle in the science of the human mind. If the arguments here adduced be admitted to be valid, it necessarily follows, that whatever can be adequately brought home to the conviction of the understanding, may be depended upon as affording a secure hold upon the conduct. There is no conduct, in itself reasonable, which the refutation of error, and dissipating of uncertainty, will not make appear to be such. There is no conduct which can be shown to be reasonable, the reasons of which may not sooner or later be made impressive, irresistible, and matter of habitual recollection. Lastly, there is no conduct, the reasons of which are thus conclusive and thus communicated, which will not infallibly and uniformly be adopted by the man to whom they are communicated.

20. The corollaries respecting political truth, deducible from the simple proposition, which seems clearly established by the reasonings of the present chapter, that the voluntary actions of men are in all instances conformable to the deductions of their understanding, are of the highest importance. Hence we may infer what are the hopes and prospects of human improvement. The doctrine which may be founded upon these principles, may perhaps best be expressed in the five following propositions: Sound reasoning and truth, when adequately communicated, must always be victorious over error: Sound reasoning and truth are capable of being so communicated: Truth is omnipotent: The vices and moral weakness of man

are not invincible: Man is perfectible, or in other words susceptible of perpetual improvement.

OBSERVATIONS ON THE PRECEDING SECTION.

This section is so much of the same tenor that its paragraphs do not require eparate observation. The general reasoning of the whole seems unimpeachable, but the conclusions with regard to a much more perfect state of society, are perhaps inadmissible. The very last sentence of the section appears o afford a foundation for objection to it. If society is ever to bein a state of improvement, then an infinite degree of error must always exist, for that must be infinite from which perpetual deductions are making, but which is never exhausted; and an infinite quantity of error, and consequently of vice, will ever hold society not only at an infinite distance from high perfection, but necessarily embroiled in quarrels and in warfare.

This opinion, afforded by the preceding doctrine itself, is confirmed by what appears to me to be the correct theory of good and evil. If pleasure and pain be relative sensations, and if the existence of the one, in all its degrees, be necessary even to our knowledge of the existence of the other in its degrees, it follows, that the existence of pain is necessary to the existence of pleasure, and the existence of evil—the means of the one, is of course equally necessary to the existence of good—the means of the other. Now if evil be necessary to the existence of good, and even the degrees of the one necessary to the degrees of the other, it follows, that the highest state of moral and political improvement would necessarily be alloyed with the greatest moral and political calamities.

So much for theory: experience confirms it. The highest states of civilization have ever been speedily succeeded by states which are the reverse. The history of every age illustrates this. India, Egypt, Greece, Rome had their day of political splendour, and their night of darkness. Europe, at this moment, affords an example of it. A little more of bloodshed, oppression and the proscription of thought (which I trust will not be permitted) would, from a state of high civilization, plunge her into an age of barbarism.

Still it is obvious that such considerations should not check improvement; for that would be voluntarily to abandon the surest source of happiness.

IV. OF FREE WILL AND NECESSITY.

1. Of the many controversies which have been excited relative to the operation of opinion, none are of more importance, than the question respecting free will and necessity. We will first endeavour to establish the proposition, that all the actions of men are necessary.

2. He who affirms that all actions are necessary, means that the man, who is acquainted with all the circumstances under which a living or intelligent being is placed upon any given occasion, is qualified to predict the conduct he will hold, with as much certainty as he can predict any of the phenomena of inanimate nature. Upon this question, the advocate of liberty, in the philosophical sense, must join issue. He must, if he mean any thing, deny this certainty of conjunction between moral antecedents and consequents. Where all is constant and invariable, and the events that arise uniformly correspond to the circumstances in which they originate, there can be no liberty.

3. It is generally acknowledged that, in the events of the material universe, every thing is subjected to this necessity. Let us recollect what is the species of evidence that has satisfied philosophers upon this point. Their only solid ground of reasoning has been from experience. The argument which has induced mankind to conceive of the universe as governed by certain laws, has been, an observed similarity in the succession of events. No experiments we are able to make, no reasonings we are able to deduce, can ever instruct us in the principle of causation, or show us for what reason it is that one event has, in every instance in which it has been known to occur, been the precursor of another event of a given description. Yet this observation does not, in the slightest degree, invalidate our inference from one event to another, or affect the operations of moral prudence and expectation.

4. Let us proceed to apply these reasonings concerning matter, to the illustration of the theory of mind. Is it possible, in this latter theory, as in the former subject, to discover any general principles? Can intellect be made a topic of science? Are we able to reduce the multiplied phenomena of mind to any certain standard of reasoning? If the affirmative of these questions be conceded, the inevitable consequence appears to be, that mind, as well as matter, exhibits a constant conjunction of events, and furnishes all the ground that any subject will afford for an opinion of necessity. That mind

is a topic of science, may be argued from all those branches of literature and enquiry which have mind for their subject. What species of amusement or instruction would history afford, if there were no ground of inference from moral antecedents to their consequents, if certain temptations and inducements did not, in all ages and climates, introduce a certain series of actions, if we were unable to trace a method and unity of system in men's tempers, propensities and transactions? But, upon the supposition on which we are arguing, all objects would be irregular and disjunct, without the possibility of affording any grounds of reasoning or principles of science. If there were not this original and essential conjunction between motives and actions, and, which forms one particular branch of this principle, between men's past and future actions, there could be no such thing as character, or as a ground of inference, enabling us to predict what men would be, from what they have been. From the same idea of regularity and conjunction, arise all the schemes of policy, in consequence of which men propose to themselves, by a certain plan of conduct to prevail upon others to become the tools and instruments of their purposes. Lastly, if I carefully persuade, exhort and exhibit motives to another, it is because I believe that motives have a tendency to influence his conduct. If I reward or punish him, either with a view to his own improvement, or as an example to others, it is because I have been led to believe that rewards and punishments are calculated to affect the dispositions and practices of mankind.

5. There is but one conceivable objection, against the inference from these premises to the necessity of human actions. It may be alledged, that "though there is a real coherence between motives and actions, yet this coherence may not amount to a certainty, and, of consequence, the mind still retains an inherent activity, by which it can at pleasure supersede and dissolve it. Thus for example, when I address argument and persuasion to my neighbour, to induce him to adopt a certain species of conduct, I make a reserve for a certain faculty of liberty he is supposed to possess, which may at last counteract the best digested projects."

6. But in this objection there is nothing peculiar to the case of mind. It is just so in matter. I see a part only of the premises, and therefore can pronounce only with uncertainty upon the conclusion. A philosophical experiment which has succeeded a hundred times, may altogether fail in the next trial. But what does the philosopher conclude from this? Not that there is a liberty of choice in his instruments, or his materials,

by which they baffle the best formed expectations. Not that the established order of antecedents and consequents is imperfect, and that part of the consequent happens without an antecedent. But that there was some other antecedent concerned, to which at the time, he failed to advert, but which a fresh investigation will probably lay open to him. When the science of the material universe was in its infancy, men were sufficiently prompt to refer events to accident and chance; but the further they have extended their enquires and observation, the more reason they have found to conclude, that every thing takes place according to necessary and universal laws. The case is exactly parallel with respect to mind. The politician and the philosopher, however they may speculatively entertain the opinion of free will, never think of introducing it into their scheme of accounting for events. If an incident turn out otherwise than they expected, they take it for granted, that there was some unobserved bias, some habit of thinking, some prejudice of education, some singular association of ideas, that disappointed their prediction; and, if they be of an active and enterprising temper, they return, like the natural philosopher, to search out the secret spring of this unlooked-for event.

7. Another argument in favour of the doctrine of necessity not less clear and irresistible than that from the uniformity of conjunction of antecedents and consequents, will arise from a reference to the nature of voluntary action. The motions of the animal system distribute themselves into two great classes, voluntary and involuntary. "Voluntary action," as we formerly observed, "is, where the event is foreseen, previously to its occurrence, and the hope or fear of that event, forms the excitement, prompting our effort to forward or retard it." Here then the advocates of intellectual liberty have a clear dilemma proposed to their choice. They are aware that to ascribe freedom to that which is involuntary, even if the assumption could be maintained, would be altogether foreign to the great subject of moral, theological or political enquiry. But, on the other hand, to ascribe freedom to our voluntary actions, is an express contradiction in terms. No motion is voluntary, any further than it is accompanied with intention and design, and has for its proper antecedent, the apprehension of an end to be accomplished. So far as it flows, in any degree, from another source it is involuntary.

8. The truth of the doctrine of necessity will be still more evident, if we consider the absurdity of the opposite hypothesis. One of its principle ingredients is self-determination. Our external actions are then said to be free, when they truly result

from the determination of the mind. If our volitions, or internal acts, be also free, they must in like manner result from the determination of the mind, or in other words, "the mind in adopting them" must be "self-determined." Now nothing can be more evident, than that that in which the mind exercises its freedom, must be an act of the mind. Liberty therefore, according to this hypothesis, consists in this, that every choice we make, has been chosen by us, and every act of the mind, been preceded and produced by an act of the mind. This is so true, that, in reality, the ultimate act is not styled free, from any quality of its own, but because the mind, in adopting it, was self-determined, that is, because it was preceded by another act. The ultimate act resulted completely from the determination that was its precursor. It was itself necessary; and, if we would look for freedom, it must be to that preceding act. But, in that preceding act also, if the mind were free, it was self-determined, that is, this volition was chosen by a preceding volition, and, by the same reasoning, this also by another antecedent to itself. All the acts, except the first, were necessary, and followed each other, as inevitably as the links of a chain do, when the first link is drawn forward. But then neither was this first act free, unless the mind in adopting it were self-determined, that is, unless this act were chosen by a preceding act. Trace back the chain as far as you please, every act at which you arrive is necessary. That act, which gives the character of freedom to the whole, can never be discovered; and, if it could, in its own nature it would include a contradiction.

9. Another idea which belongs to the hypothesis of free will, is, that the mind is not necessarily inclined this way or that, by the motives which are presented to it, by the clearness or obscurity with which they are apprehended, or by the temper and character which preceding habits may have generated; but that, by its inherent activity, it is equally capable of proceeding either way, and passes to its determination from a previous state of absolute indifference. Now what sort of activity is that, which is equally inclined to all kinds of actions? Let us suppose a particle of matter endowed with an inherent propensity to motion. This propensity must either be to move in one particular direction, and then it must for ever move in that direction, unless counteracted by some external impression; or it must have an equal tendency to all directions, and then the result must be a state of perpetual rest.

10. The absurdity of this consequence is so evident, that the advocates of intellectual liberty have endeavoured to destroy

its force, by means of a distinction. "Motive," it has been said, "is indeed the occasion, the *sine qua non* of volition, but it has no inherent power to compel volition. Its influence depends upon the free and unconstrained surrender of the mind. Between opposite motives and considerations, the mind can choose as it pleases, and, by its determination, can convert the motive which is weak and insufficient in the comparison, into the strongest." But this hypothesis will be found exceedingly inadequate to the purpose for which it is produced. It may easily be shown, that motives must either have a fixed and certain relation to their consequents, or they can have none. For, first, it must be remembered, that the ground or reason of any event, of whatever nature it be, must be contained among the circumstances which precede that event. The mind is supposed to be in a state of previous indifference, and therefore cannot be, in itself considered, the source of the particular choice that is made. There is a motive on one side and a motive on the other: and between these lie the true ground and reason of preference. But, wherever there is tendency to preference, there may be degrees of tendency. If the degrees be equal, preference cannot follow: it is equivalent to the putting equal weights into the opposite scales of a balance. If one of them have a greater tendency to preference than the other, that which has the greatest tendency, must ultimately prevail. Secondly, if motive have not a necessary influence, it is altogether superfluous. The mind cannot first choose to be influenced by a motive, and afterwards submit to its operation: for in that case the preference would belong wholly to this previous volition. The determination would in reality be complete in the first instance; and the motive, which came in afterwards, might be the pretext, but could not be the true source of the proceeding. Lastly, it may be observed upon the hypothesis of free will, that the whole system is built upon a distinction where there is no difference, to wit, a distinction between the intellectual and active powers of the mind. A mysterious philosophy taught men to suppose, that, when an object was already felt to be desirable, there was need of some distinct power to put the body in motion. But reason finds no ground for this supposition. We need only attend to the obvious meaning of the terms, in order to perceive that the will is merely, as it has been happily termed, "the last act of the understanding," "one of the different cases of the association of ideas." What indeed is preference, but a feeling of something that really inheres, or is supposed to inhere, in the objects themselves? It is the comparison, true or erroneous, which

the mind makes, respecting such things as are brought into competition with each other. If this fact had been sufficiently attended to, the freedom of the will would never have been gravely maintained by philosophical writers; since no man ever imagined, that we were free to feel or not to feel an impression made upon our organs, and to believe or not to believe a proposition demonstrated to our understanding.

11. It must be unnecessary to add any thing further on this head, unless it be a momentary recollection of the sort of benefit that freedom of the will would confer upon us, supposing it possible. Man being, as we have here found him to be, a creature, whose actions flow from the simplest principle, and who is governed by the apprehensions of his understanding, nothing further is requisite but the improvement of his reasoning faculty, to make him virtuous and happy. But did he possess a faculty independent of the understanding, and capable of resisting from mere caprice the most powerful arguments, the best education and the most sedulous instruction might be of no use to him. This freedom we shall easily perceive to be his bane and his curse; and the only hope of lasting benefit to the species, would be, by drawing closer the connection between the external motions and the understanding, wholly to extirpate it. The virtuous man, in proportion to his improvement, will be under the constant influence of fixed and invariable principles; and such a being as we conceive God to be, can never in any one instance have exercised this liberty, that is, can never have acted in a foolish and tyrannical manner. Freedom of the will is absurdly represented as necessary to render the mind susceptible of moral principles; but in reality, so far as we act with liberty, so far as we are independent of motives, our conduct is as independent of morality as it is of reason, nor is it possible that we should deserve either praise or blame for a proceeding thus capricious and indisciplinablet

OBSERVATIONS ON THE PRECEDING SECTION.

In this excellent section, there is nothing objectionable except that the third and fourth paragraphs imply the truth of the sceptical system of Hume—a doctrine fortunately by no means necessary to the general truth of the section. The falsity of the Humean doctrine was proven in the last volume of the Archives, and therefore need not, on the present occasion, be repeated.

V. INFERENCES FROM THE DOCTRINE OF NECESSITY.

1. First then it appears, that man is in no case, strictly speaking, the beginner of any event or series of events that takes place in the universe, but only the vehicle through which certain antecedents operate, which antecedents, if he were supposed not to exist, would cease to have that operation.

2. Is this view of things incompatible with the existence of virtue? If by virtue we understand, the operation of an intelligent being in the exercise of an optional power, so that, under the same precise circumstances, it might or might not have taken place, undoubtedly it will annihilate it. But the doctrine of necessity does not overturn the nature of things. Happiness and misery, wisdom and error will still be distinct from each other, and there will still be a correspondence between them. Wherever there is that which may be the means of pleasure or pain to a sensitive being, there is ground for preference and desire, or on the contrary for neglect and aversion. Benevolence and wisdom will be objects worthy to be desired, selfishness and error worthy to be disliked. If therefore by virtue we mean, that principle which asserts the preference of the former over the latter, its reality will remain undiminished by the doctrine of necessity.

3. But, if the doctrine of necessity do not annihilate virtue, it tends to introduce a great change into our ideas respecting it. According to this doctrine it will be absurd for a man to say, "I will exert myself," "I will take care to remember," or even "I will do this." All these expressions imply as if man were, or could be, something else than what motives make him. Man is in reality a passive, and not an active being. If we were constantly aware of this, our minds would not glow less ardently with the love of truth, justice, happiness and mankind. We should have a firmness and simplicity in our conduct, not wasting itself in fruitless struggles and regrets, not hurried along with infantine impatience, but seeing actions with their consequences, and calmly and unreservedly given up to the influence of those comprehensive views which this doctrine inspires.

4. As to our conduct towards others, in instances where we were concerned to improve and meliorate their minds, we should address our representations and remonstrances to them with double confidence. The believer in free-will, can expostulate with, or correct, his pupil, with faint and uncertain hopes, conscious that the clearest exhibition of truth is impotent, when

brought into contest with the unhearing and indisciplinable faculty of will; or in reality, if he were consistent, secure that it could produce no effect. The necessarian on the contrary employs real antecedents, and has a right to expect real effects.

5. But, though he would represent, he would not exhort, for this is a term without a meaning. He would suggest motives to the mind, but he would not call upon it to comply, as if it had a power to comply, or not to comply. His office would consist of two parts, the exhibition of motives to the pursuit of a certain end, and the delineation of the easiest and most effectual way of attaining that end.

6. At first sight it may appear as if, the moment I was satisfied that I was the passive instrument of causes exterior to myself, I should become indifferent to the objects which had hitherto interested me the most deeply, and lose all that inflexible perseverance, which seems inseparable from great undertakings. But this cannot be the true state of the case. The more I resign myself to the influence of truth, the clearer will be my perception of it. The less I am interrupted by questions of liberty and caprice, of attention and indolence, the more uniform will be my constancy. Nothing could be more unreasonable, than that the sentiment of necessity should produce in me a spirit of neutrality and indifference. The more certain is the conjunction between antecedents and consequents, the more cheerfulness should I feel in yielding to painful and laborious employments.

7. It is common for men impressed with the opinion of free will, to entertain resentment, indignation, and anger, against those who fall into the commission of vice. How much of these feelings is just, and how much erroneous? The difference between virtue and vice, will equally remain upon the opposite hypothesis. Vice therefore must be an object of rejection, and virtue of preference; the one must be approved, and the other disapproved. But our disapprobation of vice, will be of the same nature, as our disapprobation of an infectious distemper. One of the reasons why we are accustomed to regard the murderer with more acute feelings of displeasure, than the knife he employs, is that we find a more dangerous property, and greater cause for apprehension, in the one than in the other. The knife is only accidentally an object of terror, but against the murderer we can never be enough upon our guard. Independently therefore of the idea of freedom, mankind in general will find in the enormously vicious a sufficient motive of apprehension and displeasure. With the addition of that

idea, it is no wonder that they should be prompted to sentiments of the most intemperate abhorrence.

8. These sentiments obviously lead, to the examination of the prevailing conceptions on the subject of punishment. The doctrine of necessity, would teach us to class punishment in the list of the means we possess of influencing the human mind, and may induce us to enquire into its utility, as an instrument for reforming error. The more the human mind can be shown to be under the influence of motive, the more certain it is that punishment will produce a great and unequivocal effect. Yet the doctrine of necessity will teach us to look upon punishment with no complacence, and at all times to prefer the most direct means of encountering error, the developement of truth. Whenever punishment is employed under this system, it will be employed, not for any intrinsic recommendation it possesses, but only as it shall appear to conduce to general utility. On the contrary it is usually imagined, that, independently of the supposed utility of punishment, there is proper desert in the criminal, a certain fitness in the nature of things that renders pain the suitable concomitant of vice. It is therefore frequently said, that it is not enough that a murderer should be transported to a desert island, where there should be no danger that his malignant propensities should ever again have opportunity to act; but that it is also right the indignation of mankind against him, should express itself, in the infliction of some actual ignominy and pain. On the contrary, under the system of necessity, the terms, guilt, crime, desert and accountableness, in the abstract and general sense in which they have sometimes been applied, have no place.

9. Correlative to the feelings of resentment, indignation and anger against the offences of others, are those of repentance, contrition and sorrow for our own. As long as we admit of an essential difference between virtue and vice, no doubt all erroneous conduct, whether of ourselves or others, will be regarded with disapprobation. But it will in both cases be considered, under the system of necessity, as a link in the great chain of events, which could not have been otherwise than it is. We shall therefore no more be disposed to repent of our own faults, than of the faults of others. It will be proper to view them both, as actions injurious to the public good, and the repetition of which is to be deprecated. Amidst our present imperfections, it will perhaps be useful to recollect what is the error by which we are most easily seduced. But, in proportion as our views extend, we shall find motives sufficient to

the practice of virtue, without a partial retrospect to ourselves, or a recollection of our own propensities and habits.

10. In the ideas annexed to the words resentment and repentance, there is some mixture of true judgment and a sound conception of the nature of things. There is perhaps still more justice, in the notions conveyed by praise and blame, though these also have been vitiated and distorted by the hypothesis of liberty. When I speak of a beautiful landscape or an agreeable sensation, I employ the language of panegyric. I employ it still more emphatically, when I speak of a good action; because I am conscious, that the panegyric to which it is entitled, has a tendency to procure a repetition of such actions. So far as praise implies nothing more than this, it perfectly accords with the severest philosophy. So far as it implies, that the man could have abstained from the virtuous action I applaud, it belongs only to the delusive system of liberty.

11. A further consequence of the doctrine of necessity, is its tendency to make us survey all events with a tranquil and placid temper, and approve and disapprove without impeachment to our self-possession. He who regards all things past, present, and to come, as links of an indissoluble chain, will, as often as he recollects this comprehensive view, find himself assisted to surmount the tumult of passion; and be enabled to reflect upon the moral concerns of mankind with the same clearness of perception, the same firmness of judgment, and the same constancy of temper, as we are accustomed to do upon the truths of geometry. This however must be expected to be no more than a temporary exertion. Man is the creature of habit; and it is impossible for him to lose those things which afforded him a series of pleasurable sensations, without finding his thoughts in some degree unhinged, and being obliged, under the pressure of considerable disadvantages, to seek, in paths untried, and in new associations, a substitute for the benefits of which he has been deprived.

12. It would be of infinite importance to the cause of science and virtue, to express ourselves upon all occasions in the language of necessity. The contrary language is perpetually intruding, and it is difficult to speak two sentences, upon any topic connected with human action, without it. The expressions of both hypotheses are mixed in inextricable confusion, just as the belief of both hypotheses, however incompatible, will be found to exist in all uninstructed minds.

OBSERVATIONS ON THE PRECEDING SECTION.

This section, which affords little room for objection, concludes the physiological part of the system of Mr Godwin. The next section is rather referable to the next department of science or literature, since it almost entirely consists of an enquiry into the origin of language, blended with other observations on mental physiology.

VI. HUMAN INVENTIONS SUSCEPTIBLE OF PERPETUAL IMPROVEMENT, ILLUSTRATED BY THE STRUCTURE OF LANGUAGE.

An opinion has been extensively entertained, "that the differences of the human species in different ages and countries, particularly so far as relates to moral principles of conduct, are extremely insignificant and trifling; that we are deceived in this respect by distance and confounded by glare; but that in reality the virtues and vices of men, collectively taken, always have remained, and of consequence," it is said, "always will remain, nearly at the same point." The erroneousness of this opinion will perhaps be more completely exposed, by a summary recollection of the actual history of our species, than by the closest deductions of abstract reason. Let us carry back our minds to man in his original state, a being capable of impressions and knowledge to an unbounded extent, but not having as yet received the one or cultivated the other; let us contrast this being with all that science and genius have effected; and hence we may form some idea what it is of which human nature is capable.

2. One of the acquisitions most evidently requisite as a preliminary to our present improvements, is that of language. Its beginning was probably from those involuntary cries, which infants, for example, are found to utter in the earliest stages of their existence, and which, previously to the idea of exciting pity or procuring assistance, spontaneously arise from the opetion of pain upon our animal frame. These cries, when actually uttered, become a subject of perception to him by whom they are uttered; and, being observed to be constantly associated with certain antecedent impressions and to excite the idea of those impressions in the hearer, may afterwards be repeated from reflection and the desire of relief. But the distance is extreme from this simple mode of communication, which we pos-

sess in common with some of the inferior animals, to all the analysis and abstraction which languages require.

2. Abstraction indeed, though, as it is commonly understood, it be one of the sublimest operations of mind, is in some sort coeval with and inseparable from the existence of mind. The question, whether or not the human mind is capable of forming abstract ideas, has been the subject of much profound and serious disquisition. It is certain that we have a general standard of some sort, in consequence of which, if an animal is presented to our view, we can in most cases decide that it is, or is not, a horse, a man, &c.; nor is it to be imagined that we should be unable to form such judgments, even if we were denied the use of speech.

3. It is a curious fact, and on that account worthy to be mentioned in this place, that the human mind is perhaps incapable of entertaining any but general ideas. Take, for example, a wine glass. If, after this glass is withdrawn, I present to you another from the same set, you will probably be unable to determine whether it is another or the same. It is with a like inattention that people in general view a flock of sheep. The shepherd only distinguishes the features of every one of his sheep from the features of every other. But it is impossible so to individualise our remarks, as to cause our idea to be truly particular, and not special. Thus there are memorable instances of one man so nearly resembling another, as to be able to pass himself upon the wife and all the relatives of this man, as if he were the same.

4. The opposition which has been so ingeniously maintained against the doctrine of abstract ideas, seems chiefly to have arisen from a habit of using the term idea, not, as Locke has done, for every conception that can exist in the mind, but as constantly descriptive of an image, or picture. The following view of the subject will perhaps serve in some degree to remove any ambiguity that might continue to rest upon it. . . Ideas, considering that term as comprehending all perceptions, both primary, or of the senses, and secondary, or of the memory, may be divided into three classes: 1. such as those which are produced in us by a near and careful inspection of any visible object; 2. such as those produced by a slight and distant view; 3. so as to have no resemblance to an image of any external object. The perception produced in us in slight and current discourse by the words, river, field, are of this nature; and have no more resemblance to the image of any visible object, than the perception ordinarily produced in us by the words, conquest, government, virtue.

5. The next step to simple perception is that of comparison, or the coupling together of two ideas and the perception of their resemblances and differences. Without comparison there can be no preference, and without preference no voluntary action. Comparison immediately leads to imperfect abstraction. The sensation of to-day is classed, if similar, with the sensation of yesterday, and an inference is made respecting the conduct to be adopted. Without this degree of abstraction, the faint dawnings of language already described, could never have existed. Abstraction, which was necessary to the first existence of language, is again assisted in its operations by language. The generalisation, which is implied in the very notion of a thinking being, being thus embodied and rendered a matter of sensible impression, makes the mind acquainted with its own powers, and creates a restless desire after further progress.

6. The distance is immeasurable, between the three or four vague and inarticulate sounds uttered by animals, and the copiousness of lexicography or the regularity of grammar. The general and special names by which things are at first complicated and afterwards divided, the names by which properties are separated from their substances, and powers from both, the comprehensive distribution of parts of speech, verbs, adjectives and particles, the inflections of words by which the change of their terminations changes their meaning through a variety of shadings, their concords and their governments, all of them present us with such a boundless catalogue of science, that he, who on the one hand did not know that the last task had been actually performed, or who, on the other, was not intimately acquainted with the progressive nature of mind, would pronounce the accomplishment of them impossible.

7. A second invention, well calculated to impress us with a sense of the progressive nature of man, is that of alphabetical writing. Hieroglyphical or picture-writing appears at some time to have been universal, and the difficulty of conceiving the gradation from this to alphabetical is so great, as to have induced Hartley, one of the most acute philosophical writers, to have recourse to miraculous interposition as the only adequate solution.

8. In China, hieroglyphical writing has never been superseded by alphabetical, and this from the very nature of their language, which is considerably monosyllabic, the same sound being made to signify a great variety of objects, by means of certain shadings of tone too delicate for any alphabet to represent. They have, however, two kinds of writ-

ing, one for the learned and another for the vulgar. The learned adhere closely to their hieroglyphical writing, representing every word by its corresponding picture; but the vulgar are frequent in their deviations from it.

9. Hieroglyphical writing and speech may indeed be considered in the first instance as two languages running parallel to each other, but with no necessary connection. The picture and the word, each of them, represent the idea, one as immediately as the other. But, though independent, they will become accidentally associated; the picture at first imperfectly, and afterwards more constantly, suggesting the idea of correspondent sound. It is in this manner that the mercantile classes of China began to corrupt, as it is styled, their hieroglyphical writing. They had a word suppose of two syllables to write. The character appropriate to that word they were not acquainted with, or it failed to suggest itself to their memory. Each of the syllables, however, was a distinct word in the language, and the characters belonging to them perfectly familiar. The expedient that suggested itself was to write these two characters with a mark signifying their union, though in reality the characters had hitherto been appropriated to ideas of a different sort, wholly unconnected with that now intended to be conveyed. Thus a sort of rebus or charade was produced. In other cases the word, though monosyllabic, was capable of being divided into two sounds, and the same process was employed. This is a first step towards alphabetical analysis. Some word, such as the interjection *O!* or the particle *A*, is already a sound perfectly simple, and thus furnishes a first stone to the edifice. But, though these ideas may perhaps present us with a faint view of the manner in which an alphabet was produced, yet the actual production of a complete alphabet is perhaps, of all human discoveries, that which required the most persevering reflection, the luckiest concurrence of circumstances, and the most patient and gradual progress.

10. Let us, however, suppose man to have gained the two first elements of knowledge, speaking and writing; let us trace him through all his subsequent improvements, through whatever constitutes the inequality between Newton and the ploughman, and indeed much more than this, since the most ignorant ploughman in civilized society is infinitely different from what he would have been, when stripped of all the benefits he has derived from literature and the arts. Let us survey the earth covered with the labours of man, houses, enclosures, harvests, manufactures, instruments, machines, together with

all the wonders of painting, poetry, eloquence and philosophy.

11. Such was man in his original state, and such is man as we at present behold him. Is it possible for us to contemplate what he has already done, without being impressed with a strong presentiment of the improvement he has yet to accomplish? There is no science that is not capable of additions; there is no art that may not be carried to a still higher perfection. If this be true of all other sciences, why not of morals? If this be true of all other arts, why not of social institution? The very conception of this as possible, is in the highest degree encouraging. If we can still further demonstrate it to be a part of the natural and regular progress of mind, our confidence and our hopes will then be complete. This is the temper with which we ought to engage in the study of political truth. Let us look back, that we may profit by the experience of mankind; but let us not look back, as if the wisdom of our ancestors was such, as to leave no room for future improvement.

OBSERVATIONS ON THE PRECEDING SECTION.

This section contains the chief of Mr Godwin's observations on literature, properly so called; and, as that is its natural order, I have placed it after the physiological and before the moral part of the work.

I can by no means accord with Mr Godwin respecting the value of alphabetical writing, mentioned in the seventh paragraph. If it be compared with hieroglyphical (understood as picture writing, which the author seems to do), its value is incomparably less: it consists of arbitrary instead of natural signs, as I have shown in the preceding paper on natural language, and instead of 'miraculous interposition' being necessary to explain its discovery, the only interposition that appears to me to have been necessary was that of a peasant perhaps or an old woman, who, incapable of forming the picture of the object, put a O, or a I, or a + in lieu, just as the illiterate sometimes put the last of these arbitrary signs in lieu of their names.

Hieroglyphical or picture writing, for Mr Godwin understands them to mean the same, and spoken language, cannot, as stated in the ninth paragraph, 'be considered in the first instance as two languages running parallel to each other, but with no necessary connection.' If, on the contrary, the

spoken language were as natural as the picture writing, the most intimate connexion must subsist between them: they would naturally be bound together, the one differing from the other only in being the natural written, the other the natural spoken sign of the same object or idea. No connection can possibly be closer than this.

Some of Mr Godwin's reasoning on this subject may, however, originate in confounding hieroglyphical with correct picture writing. Though alphabetical writing be far inferior to the latter, yet it is certainly superior to the former; that is, perfect arbitrary, though unnatural characters, are preferable to defective and incorrect natural ones.

N. B. Having thus concluded the analysis of the physiological, and of the literary part of the system of Mr Godwin, we arrive at that which should properly be termed the moral part of it, but must here at present conclude the analysis, on account of the extent which the first part of the present volume has now acquired. Both the moral and political part of this system will be concluded in the subsequent volume; and, as an analysis of an important political system has been unavoidably omitted both in this and in the preceding volume, two additional ones will also be given in the following volume, namely, those of the systems of Machiavelli (as delivered in his discourses), and of Lord Bacon.

PATENT OFFICE LIBRARY.

SIXTH DEPARTMENT OF SCIENCE, OR POLITICS.

HISTORY, ETC.

HISTORY OF THE PERIOD, WITH POLITICAL REFLEXIONS.

BY THE EDITOR.

SPAIN.

Before proceeding to consider the particular events in Spain, it will be highly proper to peruse the manifesto lately addressed by the Spanish nation to Europe.

MANIFESTO OF THE SPANISH NATION TO EUROPE.

" Nations and communities of Europe, Princes, good men of all classes and in all conditions, the Spanish people, and in their name the Directing Junta, to whom, on account of the unjust and iniquitous imprisonment of their King, authority is confided, undertake to lay before you a history of the misfortunes and grievances they have endured, and, in presenting to you a faithful picture of their situation, and a candid exposure of their designs, they assure themselves of your com-

passion for their calamities, and of your solicitude for their fate.

" All the world has witnessed the constant adherence of Spain to the cause of France, and the uninterupted friendship she has preserved during an entire century. War against the one was hostility against the other—peace with the one was tranquillity with the other—their alliances and their connections were ever the same; but France by her preponderance in Europe, by the superior influence of her Sovereigns, was considered the principal branch of the family of the Bourbons, and as such regulated the enterprizes and directed the operations of both. Consequently, all the benefit of this union wa her own, and Spain derived no other utility and no other glory from it, than as being the first and most powerful instrument of the aggrandisement of her ally.

" This union subsisted until the Revolution of France, when the expulsion of the family from the throne of their ancestors, abrogated for ever the compact. Other views, other relations, different external policy was necessary under these new circumstances to the Spanish Monarchy, and Charles IV. appeared willing to adopt them, when, in 1793, he declared war against France, and joined his forces with those of the Coalition of Europe. But the Favourite (Manuel de Godoy, Prince of the Peace,) who possessed uncontrouled influence in our councils, wretchedly conducted our operations in the hour of conflict, and our arrangements in the interval of tranquillity. To an unsuccessful war succeeded a disgraceful peace, and to this disgraceful peace an unequal and ruinous alliance, and and from that time to the present, Spain has been tied to the wheels of French destiny, and has been lacerated in its rapid and devious course.

" How was it that the benefits of this alliance also were always with France? Her industry was rendered productive by the support of the treasures of Spain and the Indies. Our armies were her's and not less our ports, our shipping, and we may add, our Colonies. This near relationship between the two Powers, was maintained on our part by good faith and unreserved friendship; we always received them as brethren, and, in their two expeditions into Spain, our peasants deprived themselves of bread, in times of great scarcity, to administer to the wants of their troops; and even our women abandoned their beds, to give to the tired soldiers the comfort of repose. Let Frenchmen not forget these services—let those of them that are capable of shame blush for their crimes. Those will feel no remorse who have resigned all that constitutes the

solace, the happiness and the dignity of man, to accomplish the political purposes of one whose thirst of power is insatiable.

" And what are the advantages that Spain has derived from this unnatural alliance? Two maritime wars equally fatal—our squadrons sacrificed to the cautious policy of our present allies—valuable colonies lost—an interruption given to our connexion with America—the principal nerve of our national industry, Louisiana, exchanged with the French for Etruria, and immediately sold, contrary to the express terms of the alienation—Etruria, the price of this concession, and of immense sums besides, in the sequel, violently forced from the prince who possessed it—a copious stream of silver and gold which flowed from Spain to France to appease the avarice of her governors—in fine, the wild administration of the Favourite, protected and supported by her, is another of the bitter fruits of this misapplied friendship.

" The constant and only object which governed our cabinet, was to satisfy the expectation of the French. Charles always contemplated them as the promoters of his ruin; but the Favourite sacrificed every thing to his own preservation, and there was no meanness, no servile submission, to which, for their purposes, he would not condescend. Our Princes forgot that love and respect for their people should be the guides of their conduct, and were the best securities against the aggressions of power. From concession to concession, from fraud to fraud, blinded by a fatal lethargy, they hurried onward to their ruin, and expected their safety from the serpent that meditated their destruction.

" The devouring flame, that in its progress had swallowed up Italy and Holland, that had subverted the political system of Germany, and exterminated Prussia, was arrested in its progress by the peace of Tilsit, but returned with violence to spend its fury in the west. The unjust possession of Portugal, and reported expedition to Africa, were the pretexts for the introduction of French troops into Spain; and the offer of a sovereignty in that kingdom to the Favourite, was the temptation of the Favourite to accede to these designs. To these arrangements was added the scandalous transactions of the Escurial; the unhappy divisions among the Royal Family, produced by French intrigue and perfidy: Spain and Europe heard with astonishment the charge of parricide adduced by Charles the Fourth against his successor, and they listened with horror while a father commanded the sword of justice to fall upon his first born. But Spain and Europe repelled the nefa-

rious calumny, and not a stain remained on the character of an innocent and virtuous Prince. Persecuted, deprived of the affection and confidence of his parents, his respect and obedience to them never forsook him, and his only crime was, being feared and therefore detested by the Favourite. The wretch did not venture to consummate his purpose, and alarmed at the vengeance prepared for him by Spanish loyalty, he abandoned his infamous design, and by this unsuccessful effort advanced one step nearer to the precipice from which he fell.

" In the mean while the French troops entered Spain, and Napoleon taking advantage of this shameful disunion in the Royal Family, gave the signal to his Generals to forward his purposes. The fortress of Pamplona, Barcelona, and Figueras were treacherously seized by those soldiers who were received into the country as friends and allies. When this infringement of the laws of hospitality became known, the whole kingdom was alarmed and the Government interposed; but the weak King, instead of opposing violence by violence, contented himself with listening to the idle excuses of the French, and again returned to the fatal lethargy that absorbed his faculties. They then advanced towards the Capital, and the mystery was unveiled. The disrespect with which they spake of the nation and of its Princes, increased the public inquietude; and the fears of the most incautious, who at first believed that they came to destroy the tyranny of Godoy, in the sequel were awakened. The King, himself, at last undeceived, proceeded from Madrid, on his road to Andalusia, with a view to transport himself to the western world.

" Such was the state of the Spanish people, who no longer had any hope to indulge and no respect to preserve. They saw themselves deprived of their Princes, without a Government, without a Protector, abandoned to the tender mercies of strangers, and exposed to the fate of Portugal, where the French had been received without opposition, and where, as the first specimen of reform, they confiscated all property, public and private, and levied an immense contribution as a pretended ransom for the inhabitants. Spain at length lifted up its voice, resisted the designs of the Royal Family, the Favourite devolved into that state of insignificance, in which he should have always remained, and his patrons either not willing, or not knowing how to reign without him, abdicated to the heir the throne of their Fathers.—Ferdinand the VII. was solemnly proclaimed, and universally acknowledged to be King by those who were to obey him. The nation was sud-

denly restored from death to life, confidence was re-established, and happiness reigned in every bosom. None are better acquainted than the French, if they chose for once to speak the truth, with the perfect unanimity of sentiment, and the general and loud expression of national joy which was vociferated throughout the Empire.

"The friendly relationship which yet apparently subsisted between the two countries, was not destroyed, but on the contrary, the young Monarch used his endeavours to draw still closer the bonds of affection. As Prince of Asturias he had sought the friendship of Bonaparte, had implored his protection against the oppression under which he laboured, and had even manifested a wish to be allied by marriage with his family. When Monarch of Spain and of the Indies, he was faithful to what he had before professed, and he sent an Ambassador Extraordinary to announce to the Emperor his exaltation to the Throne; repeating on the same occasion the offer of a domestic union. When he was informed that Napoleon was journeying to Spain, he dismissed his Royal brother to compliment him on his approach, and supposing from the representations of the false emissaries of Bonaparte, that the Emperor would meet him within the limits of Spain, he went himself to accelerate the interview.

"What man is there who retains any portion of the character of his species, that could be insensible to these demonstrations of friendship and confidence. Napoleon continued to deceive the King by his artifices, and the innocent victim proceeded from Burgos to Victoria, from Victoria to the Frontiers, and from the Frontiers to Bayonne. Here at last he meets with his ally, who, having entangled him in his toils, informs him, that he must renounce that Crown with which his brows had been encircled by the will of his people. In order to overcome that repugnance which Bonaparte expected in a Spanish Prince, on hearing such a degrading proposition, he contrived that the Royal Parents should meet their son at Bayonne, and revoke the abdication they had made in his favour. There assuming the character of the defender of the rights of the father against the son, availing himself of that filial reverence which never forsook the breast of Ferdinand, and triumphing over the miserable situation of all of them, he compels the son to return the Crown to his parent, and the parent to surrender it into his own hands.

"And what was the situation, what were the sentiments of the people of Spain, while this scene of disgrace and tyranny was exhibiting; while all the fundamental laws of the Mo-

narchy were violated, and all the purposes of the national will disappointed? Restrained by their loyalty and peace, as long as they could indulge a hope that their king would be acknowledged, they shewed no impatience or disgust toward the French, who, accommodated in the capital and its neighbourhood, employed the name of Ferdinand and of his Government, while they were consoled by the hospitality and courtesy of the Spanish people. But when they discovered that the King, notwithstanding the promises he had made on leaving them, did not and could not return, when they discerned the trammels in which he was enveloped in Bayonne, when they read the incendiary papers circulated with industry, defaming the happy revolution, when they learnt that the sad remains of the Royal family were brutally forced from their territories, then, and not till then, public discontent expressed itself in complaint and clamour, and the general indignation began to be manifested by open hostility.

"The French took advantage of this violent agitation, and their atrocious contrivances prepared the road for the memorable transactions of the 2d of May.—They now had recourse to the means of inspiring terror, and they thought, that by vanquishing the capital, they should conquer the nation. An opportunity soon offered, which might have been evaded by pacific expedients. Impatient of blood, inflated by tyranny, they mowed down an innocent people, and slaughter spread its wide havoc through the quiet streets of Madrid; the inhabitants rushed to arms, and hand to hand, and foot to foot, the battalions of the French were taught how to despise death by their opponents, who manifested more courage than their vile assassins, protected by the closeness of a phalanx, and all the resources of military discipline. Human blood poured its warm current through the avenues, and although unequal in number, abandoned by their Government, and deserted by their officers, who shamelessly confined themselves in their quarters, the conflict was sustained with obstinacy, and in many places, with advantage, when the accents of peace were heard with reverence from the lips of their Magistrates, and they obeyed the mandate.

"The combat ceased, and horror commenced its labours. Barbarous Frenchmen established their posts throughout the capital, and the people found with arms on their persons, or even with domestic utensils pretended to be such, were seized, and, without preparation or trial during the same night and the following morning, were butchered within sight of their own doors. During that terrible interval, the silence was only in-

terrupted by the acts of the executioner and the groans of the dying, while brave Spaniards disarmed, were prevented from inflicting a just vengeance for the murder of their brethren.

"That melancholy day transferred into the hands of Frenchmen the highest authority of the State, and the resignations from Bayonne, which immediately appeared, acquainted the people that their future fate was to depend upon the will of Napoleon. Bonaparte then ceded to his brother Joseph the Spanish Crown, and in order to sanction these acts, in the genuine style of French buffoonery, a Junta of Spaniards was convoked at Bayonne: some of the members were sold, others were imbeciles, but most of them were mere cyphers, and these puppets of the Grand Master of the show, without credentials, without any appeal to the public to obtain authority, signified their approbation of, and subscribed their names to, the miserable farrago, which Napoleon and his Secretaries distinguished by the pompous title of the Spanish Constitution.

"In this manner, after having practised whatever is vile in perfidy, and whatever is detestable in wickedness, these impudent sophists affected to speak of constitutions, laws and reforms, and not being able to exhibit any right, either just or apparent for their usurpation, they gilded over their crimes under the specious name of Public Reformers. But a nation composed of twelve millions of people requires no tutors... And, good God, who are these instructors? They are the same, that after having called themselves the defenders of the rights of man, and of all the principles of legitimate government, muster their armies to trample both on the one and the other, both within and without their own boundaries... Who are these instructors? Those who have made no law which they have not destroyed, who have established no government which they have not corrupted. These instructors are such as have alternately practised, and endured horrors without end, in order to establish that liberty which they knew not how to enjoy, and have terminated their career of infamy by becoming the degraded instruments of the most insensate ambition, with which the world has been afflicted since the days of Tamerlane. Let us no longer submit to the rapacity of these plunderers of the world, who come to rob us of that wealth which has been accumulated on our soil by the labours of a century. Let us not submit to be the vassals of this subaltern ruler, placed here only to be the mouth-piece of the tyrant. Let us not allow our youth to be transported to other countries, to cut the throats of nations who have done us no injury, as the conscripts of Italy and Germany shed our blood within our own territories. If

the ruby current of the heart must be poured forth, it is better to offer it as incense to our country, than to the ambition of a maniac. It is better to fight and die before the face of our fathers on the shores of the Tagus, the Guadalquivir and the Ebro, than to make the frozen regions of the Vistula and the Danube blush for our crimes.

"Such were the sentiments with which this generous nation was animated. The provinces rushed to arms, and having proclaimed anew their Sovereign to whom they had sworn allegiance, hastened to meet the disciplined legions of France. At first nothing could resist the impetuosity of their patriotism. Twenty-three thousand men, the flower of the French Army, commanded by one of their ablest Generals, were routed on the plains of Baylen, and compelled to surrender themselves prisoners. Valencia received within her walls the furious Moncey, and drove to the centre of the French army then established at Madrid. Afterwards the Catalonians, seeing their fortresses of Figueras and Barcelona occupied by the enemy, collect a numerous army, and Manresa and Gerona have become a warning to the troops of the enemy sent to destroy them. At last Sarragossa, open to attack on all sides, possessing no other defence but the breasts of her inhabitants, resists the attempts of Napoleon, who like an infernal monster, fulminated from his palace at Bayonne the desolation of a country, and the extermination of a people, pacific in their temper, and whose only crime was loyalty to their Prince. The vast resources of war, manufactured by ourselves, were sent from the magazines of Pamplona, and were treacherously converted into the instruments of our destruction. But the Arragonese determined to protect their city, rushed indignant upon the enemy, and in the streets of the town is written in blood the triumph of their courage.

"The French at last vanquished in every direction, seek security in flight, and establish their encampments on the shores of the Ebro. There they coop themselves up in the fortresses they had perfidiously seized, until reinforcements should arrive, supported by which, they hoped for better success. The Spanish nation, opposed in character and principles to Gallic pageantry and falsehood, will not conceal from Europe, that, in this second conflict, she has not been so highly favoured by fortune as in the former. Our troops have paid a tribute to their inexperience, and, after the victories of Espinosa, of Burgos, and of Tudela, the enemy has returned to our capital. The conquerors, with their accustomed arrogance, gave the shout of triumph, as if the narrow precincts of Madrid comprehended the whole Monarchy, and if you were to believe their story,

all our armies have vanished like the smoke of the field of battle, and Spain has neither forces to oppose her enemies, authority to regulate her councils, nor resources to protect her from annihilation. All this is false. The Government which has been chosen by the Nation, never attracted more respect, never felt more the strong principle of union, and never experienced more ardour in the public cause. At its voice, the provinces have redoubled their exertions; new enlistments, new contributions, and new sacrifices, have in an instant filled the void occasioned by these reverses. The French, instead of the idle triumph they contemplated, and the free pillage they expected, have seen themselves surrounded by fresh armies, and are obliged to concentre their forces for unlooked-for combats. The Tyrant is deceived; all his intrigues and contrivances, all his advantages and victories, will never extinguish in the breast of a single Spaniard his detestation of French government, or weaken his unremitting exertions to repair the losses he has endured from the caprices of fortune.

"Such has been the origin of a war which the French have waged against Spain, attended with every barbarity, and yet without any notice or pretext. As if the Spanish people did not belong to the civilized orders of society, none of the rules which guide the intercourse of nations, were respected by the assailants. To expose before the world the injustice we have suffered, it is not necessary that we should have recourse to subtle distinctions of public law, or to diplomatic casuistry on the construction of existing treaties. The peaceable traveller, treacherously attacked by the companion of his journey, who is metamorphosed into a foul assassin, needs few words to justify the means of self-defence to which he resorts: the law of self-preservation, the established code of society, and the natural ebullition of the passions, immediately supply his vindication. We are deprived of our princes, threatened with the abrogation of the laws and customs we venerate, and exposed to violence within the sacred enclosure of our own habitations. Those men whom we received into our dwellings, as guests and friends, have stained them with the blood of their inhabitants, whose mothers and daughters have been violated by all the filthy excesses of brutality—those mothers and daughters, too, who have first seen their husbands and parents butchered, and their children borne off in triumph on the point of the bayonet. The sanctuary of our temples has been sacrilegiously prophaned, and their defenceless priests strangled before the altar. Thus insulted by bestiality and crime, we had no option—we must either perish or conquer. We should be yet

more detestable than the Tyrant represents us, if we were not to be sensible of what, in such circumstances, is due to our ancestors, and to ourselves; and we are not disposed to appear unworthy of our progenitors, the contempt of Europe, or the minions of Napoleon. This terrible conflict in which Spain has been engaged, in its result, will not exclusively affect her interest and happiness. Sovereigns of Europe, insulted and abused; people of Europe, exposed to oppression and tyranny by the French, will you regard with indifference the only occasion which will be offered to you, of recovering your authority, of avenging your injuries, and of restoring that equilibrium which has cost you so many coalitions, and so much blood? The power and ambition of Charles the Fifth, and of Louis the Fourteenth, were opposed with success: a new tyrant, yet more terrible than his predecessors, has arisen; will you now be insensible to your danger, and in torpor and inactivity submit to your fate?

"During fifteen years, the ambition of France has been employed in agitating and destroying Italy. That country, converted into a theatre of war, has seen all the advantages of a permanent peace withdrawn, and the sublime monuments of human genius transported to gratify the pride of those who are incapable of imitating them. Listen, Italians, to the voice of a nation which formerly united her hosts in battle with your own, and humbled the haughtiness of France on the shores of the Garellano, and on the plains of Pavia. Spain no longer wishes for that authority which she once possessed over you; she invites you only to unite with her, and to answer to the call of liberty; this country, combining with your efforts, will hail the day when she can salute you as a nation, independent, great and powerful.

"Switzerland has the same calamities, the same grievances, and, perhaps, greater losses to deplore. Her proximity to France has been her ruin. Converted into a vast camp for the French military, she has been forced to resign the laws of her venerable confederation, to receive a new constitution from the French Dictators.

"Nor is there left to Holland any redress for the humiliation and opprobrium to which she is exposed. Without navigation, without commerce, without colonies, despoiled of her constitution and of her laws, obliged to acknowledge and to obey a king destitute of talent, virtue and glory, she must either consent servilely to her degradation, or appeal to those arms which her insults and misfortunes invite her to assume.

"Germany, with her ancient empire, has been subverted by the intrigues of the federative system, her liberties have been abrogated, the depots of her commerce have been emptied, and her people have been desolated by a cruel war. The monstrous Confederation of the Rhine has risen on the ruin of her shores, and the Chief of that Union, a hundred times more powerful than the Supreme Head of the Germanic Empire, will render his connexion an unnatural alliance between the weak and the strong, the slave and the tyrant. Will Austria be yet irresolute?—Has she engaged in three wars, desperate and bloody, for authority and dominion, and will she be inactive when her very existence depends upon her immediate exertion?—Does she forget by what perfidy Napoleon deceived Prussia, in order to humble her at Ulm and at Austerlitz, and how, afterwards, he availed himself of the torpor of Austria to break Prussia to atoms on the plains of Jena? Combined at a former period with Spain, she assigned limits to the impetuosity of this nation, ever restless and ambitious. Spain again invites her to war against their common adversary. If Spain falls, Austria will be crumbled into dust.

"Russia, trusting to the immense extent of her territory, may, for the present, dismiss her fears, and treat, as on equal terms, with the oppressor of the rest of the Continent; but when he has aggrandized himself with the spoils of nations, and can unite beneath his own authority the Empires of the West and of the South, then she will have to add to the destruction of her commerce, the degradation of obeying the mandates of the conqueror Napoleon.

"Yes, Princes and Nations of the Continent, your preservation is identified with ours. That grand system of continental subjugation, which is incessantly issuing from the lips of Frenchmen, comprises in their own aggrandisement your ruin. Do not deceive yourselves; the ambition of Bonaparte has already triumphed over Italy, Holland and Switzerland, and has converted the States of the Confederation of the Rhine into the provinces of his own empire. With the forces of Spain and Portugal, he intends to effect the destruction of Austria, and afterwards to assemble the collective strength of Europe to drive the unfortunate Alexander into the desarts of Tartary. Then, and not until all this is consummated, will the projects of his wild ambition be accomplished. The ancient dynasties of the earth will disappear; he and his family will reign uncontrouled over the nations; another feudal system, more repugnant than the former, will be established, to the

exclusion of the light, and to the destruction of the industry and civilization of three complete centuries.

" But the time has not yet arrived when the tyrant can enjoy the fruits of his labours. England, possessing great natural advantages, from her insular situation, from her power, and from her laws, has cast the smile of contempt at the mad convulsions of French audacity.

" What then, Sovereigns of Europe, have you to perform? You are invited to action by fair opportunity, by obvious interest, and by urgent danger. If you wish to exist, arm yourselves. From the Scheld to the Tyber, and from the Neva to the Guadalquivir, may there be but one object, and may that be, war against Frenchmen! Perhaps you doubt of a successful result from your efforts.—Be not deceived, Frenchmen are neither invulnerable nor invincible; the plains of Valencia and Zaragoza, and the mountains of Baylen, exposed to heaven and earth their shame and degradation. Oh! ye Monarchs and inhabitants of the Continent, imitate our firmness and our perseverance, and the world, threatened with destruction by a brutal Monster, will at length recover its independence and its repose.

MARTIN DE GARAY,
Secretary to the Supreme Junta.

Palace of Alcazar, Seville, Jan. 1. 1809.

The preceding admirable address was soon succeeded by the following decree.

DECREE OF THE SUPREME JUNTA.

His Majesty, considering that the French, in the unjust and barbarous war which they wage against Spain, pay no regard to any principle of the laws of nations—that they shamelessly violate the most solemn treaties, as has been verified with respect to the capitulation of Madrid, since contrary to the stipulations therein made, they imprison, persecute, and banish peaceable Citizens and respectable Magistrates, imposing, at the same time, the most disgraceful punishments on other unfortunate persons on the slightest suspicions and most frivolous pretexts.—Seing that they continue every where to defile the sanctity of temples, the purity of domestic honour, and to trample on the rights of humanity—that acts of the

most atrocious kind, and which make human nature shudder, are daily heard of, such as the death of a nun, who threw herself into a well, to avoid the brutality of a Frenchman; the cruel murder of a mother, whose breasts were cut off in the act of giving suck to her son, by those monsters, who afterwards sabred her infant; and a number of other cases equally horrible; atrocities painful to write, dreadful to read, and degrading to endure.—Finally, his Majesty being convinced, that still to observe the laws of natural equity with those who respect no law whatever, would not be moderation and justice, but the most culpable indifference and the basest meanness, has resolved to repress and punish those crimes. Calling therefore all Europe to witness the awful necessity which has compelled him to resort to the mean of retaliation, by returning on a sanguinary banditti violence for violence he hereby decrees.—

I. That no quarter shall be given to any French Soldier, Officer, or General, who may be made prisoner in any town or district, in which acts contrary to the laws of war have been committed by the enemy, but that such persons shall be immediately put to the sword, as an example to their companions and a satisfaction to outraged humanity.

II. That the present Decree shall be printed, proclaimed, and distributed in the Spanish armies, in order to its due execution. You are also required to make arrangements for the fulfilment of the same.

The Marquis of ASTORGA, Vice-President.
MARTIN DE GARAY.

Done in the Royal Alcazar of Seville, Feb. 7, 1809.

This step is highly proper, and ought, as mentioned in the first volume of the Archives, to have been adopted at the very commencement of the warfare.

In consequence of the decease of the Conde de Florida Blanca, the Marquis de Astorga has been appointed to the Presidency of the Supreme Junta. This is not to be regretted, since the conduct of Florida Blanca has not been favourable either to the general freedom of Spain, or to that of the press in particular.

Indeed of all the errors committed by the Supreme Junta of Spain, the most fatal is that which respects the press. Soon after they assumed the government, they declared the old restrictive laws to be in full force. This amounted to a prohibition of all free discussion. In the same spirit, they af-

fected the utmost secrecy upon all the transactions of the revolution and the war. Nothing could demonstrate greater ignorance of the only means by which the deliverance of Spain was to be won, and its independence to be secured, than thus to deny themselves the use of the most powerful instrument they could have to work with in their great undertaking.

This mistaken policy was the more to be blamed, because Spain is at the present time very rich in men of letters, who, rejecting the invitations of the enemy, and adhering to their duty, are anxious to exert their talents in spreading and in strengthening the patriotic enthusiasm.

It is due, in justice to distinguished individuals, to mention, that this decree respecting the press met with strong opposition from some members of the Central Junta. The enlightened Jovellanos was fully aware of all the consequences of so blind a policy, and was seconded in his remonstrances against it by Calvo, the zealous and active deputy from Zaragoza. But the bigotted and timid views of old Florida Blanca prevailed, and, after his death, the majority has still been preserved in the deliberations of the Junta, by those who were addicted to the same prejudices. The most obstinate resistance in the Junta to all measures partaking of innovation, how necessary soever to the salvation of Spain, has proceeded from a little cabal of provincial lawyers, who were unfortunately returned members of that assembly. Riquelme the deputy from Granada, Torre from Toledo, Rabe from Cordova, are of that profession. Their services in the Junta have consisted in a pertinacious struggle against every proposal that leaned towards large principles of legislation or civil liberty, which are always opposed by those mechanical drudges of the law, who, by low diligence and intrigue, thrust themselves up to affairs, of which they are wholly unqualified to judge.

The report, however, of an immediate edict announcing the Convocation of the General Cortes in Spain, gains credit every day, and is received with enthusiasm and delight by all classes of people. It is highly honourable to the little province of Asturias, in addition to the early declaration of its sentiments, and the great military exertions with which it has supported them—that of the two Deputies which it sent to the Central Junta, one, Jovellanos, is said to be the author, the other, Marquis of Campo Sagrado, a strenuous supporter of the measure, which will restore the people of Spain to their ancient rights and constitution. The deputy from Zaragoza, also, and the secretary of the Junta, Garay, who is also an Arragonese, are among the warmest of its advocates; another,

and a striking proof that those most firm and determined in the cause of national independence, are, in all communities, to be found among those who have a bias in favour of popular government, and are attached to the internal freedom of their country.

The proclamation for assembling the Cortez was to be issued on the 14th, on which day it would be known when they were to meet. This determination was brought about by Jovellanos, Calvo, and other members of the Junta, against all the influence of the pettifogging lawyers who had crept into it.

Experience has also at length brought the members of the Spanish Junta to feel the consequence of making the people parties to the war in which they are engaged. They are now, when perhaps too late, convinced, that without the press, that vilified organ, which it is the object of the corrupt in all countries to silence, no vigour can be aroused, nor any union of action created. A body of literary men, therefore, have at last been formed to enlighten the public mind, and to assist the cause of patriotism and liberty. Would to God this had been done at the commencement, and that the truth had been uniformly and candidly told.

It is said that Jovellanos, in order to give vigour to the administration of the country, has recommended, *pro tempore*, the appointment of five Dictators, to be invested with the plenary authority with which those Magistrates were anciently entrusted under the Roman institutions.

The government are adopting measures against the Bishops who have espoused the cause of the Usurper. These are immediately to be tried, and sentence pronounced against them by the Tribunal of Public Safety.

STATEMENT OF THE SPANISH ARMIES.

Of the army of Vanegas in the Carolinas, and that of Blake, soon after this period, the following are the official details:

VANEGAS.

Infantry.

Total force - - -		27,639
Sick -	7319	
Absent -	2071	
		9,390
Total effective -		18,249

Cavalry.

Total force - -	3,531 men	2,105 horses
Absent - -	415	235
Sick, &c. -	1,158	875
Total effective -	1,635	1,388

BLAKE—AT TORTOSA.

Infantry.

Total - - -	21,568
Real effective - -	16,334

Cavalry.

Total - - - -	985
Real effective - -	915

The following are pretty accurate accounts of the other armies:

CUESTA.

Head quarters at Monasterios—Advanced guards at Puerto de Canto—Cavalry in rear, near Seville.

Infantry.

Calculated at - -	25,000

Cavalry.

Calculated at - -	5,000

REDING—AT TARRAGONA.

His returns before the action of the 25th of March, and before his detachment of Lazan, were 40,000 men. Since that time he has lost and detached men, and his hospitals are full; so that he cannot have more than 20,000 disposable force.

ROMANA may have -	10,000
The ASTURIAN ARMY may be	15,000

Certain real effective force, from returns, and deduction of sick made soon after the preceding:

Vanegas - -	19,637	
Alcantara - -	3,000	
Badajos - - -	5,000	
Murela - -	4,000	
Blake - - -	17,249	
		48,886

Uncertain, but believed:

Cuesta (under calculated)	30,000	
Reding - - -	20,000	
Vives Ciudad Rodrigo -	5,000	
Romana (guess) -	10,000	
Asturians (guess) -	15,000	
		80,000
Total -		128,886

Besides the numbers reckoned above, there are in Valencia 12,000, in Grenada and neighbourhood 5,000, in Cadiz 4 or 5,000, and in Seville about 4,000, exclusive of the English 40th regiment; but the greater part of these, though incorporated and drilled, have no arms. With the armies, over what are reckoned above, there are at least 15,000 unarmed men.

The force of the enemy in Spain, was, about the same time, distributed as follows: Victor (duke of Belluno) remained inactive at Madrid. Sebastiani was in La Mancha, watching the motions of the army of General Cuesta in the vicinity of Monasterios. Marshal Mortier (duke of Treviso), with Generals Kellerman and Bonnet, had proceeded to the north west of Spain, and the right wing of their army had passed the defiles of Arbas, and advanced towards Gijon. Ney (duke of Elchingen) was represented as occupying Gallicia, and supported by this army of Mortier, instead of being confined by a superior force in Corunna, as was stated in the Spanish papers.

In the south, about the beginning of March, the Spanish army under Urbino, Count of Caltoagar, amounted to near 30,000 men, its head-quarters being at Val de Penas. The long inactivity of Urbino appears now to have arisen from

this, that he, in conjunction with others of high rank, have "been traitors to their country."

About the same time, the troops of Generals Cuesta and Albuquerque formed a junction in La Mancha, and their united forces amounted to 50,000 men.

Soon after this, the French passed the Tagus at the bridge of Arzobispo, and on the 17th of March attacked the Spaniards with one column of 12,000 men, while another column advanced, and was permitted, without interruption, to cross the river in boats, about 50 miles lower down, at Almaraz. At the former place, the resistance was obstinate and bloody; but, in the sequel, the Patriot General found it necessary to give way, and he therefore retreated to the favourable position of Santa Cruz. General Cuesta has since published a proclamation, in which he has fully explained the circumstances of his retreat, and the motives which rendered it necessary. He also has noticed the misconduct of some of the Spanish cavalry on the approach of the enemy. Four regiments of horse are said to have left the ground on this occasion, before the retreat was sounded.

A decisive victory is also claimed by the French over the army of Cuesta on the 28th of March, in which that army is said to have been annihilated, and the conquest of Andalusia secured. The Spanish account of the same transaction, admits that the French gained a victory, but attributes it to treachery, and holds out a confident hope of future success. It is certain that up to the 12th of May, no movement had taken place in the armies of Victor and Cuesta. It also appears that the army of Estramadura, commanded by General Cuesta in person, consists at present of 31,000 infantry, and 6900 cavalry. The whole of the infantry, and one half of the cavalry, are on this side of the Sierra Morena; their head-quarters being at Monasterios, and advanced post at Fuente de Cantos and Santos. The other half of the cavalry, under the command of the Duke of Aberquerque, are upon the other side of the Sierra, being quartered in the villages about Seville, on account of the scarcity of forage in Estramadura.

Previous to the 26th of May, General Sebastiani, who was in La Mancha, had fallen back, and was expected to continue his retreat to the city of Toledo, where it was supposed he would be joined by Marshal Victor advancing to Talavera de la Reyna by Caceres and Truxillo. General Vanegas was following the steps of Sebastiani towards Ciudad Real, and Cuesta those of Victor. Cuesta had already reached Me-

rida, where the French Marshal was so long encamped prior to his movement towards Lisbon.

In the east of Spain, about the middle of February, General Reding, after the fall of Zaragoza, had been exposed to the whole force of the enemy, released from the arduous duties of that protracted siege; two terrible conflicts had ensued in which the valour of the Spaniards had been eminently displayed; and in consequence some considerable advantages were obtained. But, while this was the situation of affairs, the enemy received a reinforcement of 8,000 men which encouraged him to make a third attack, when the patriots were completely routed, and General Reding, with five severe wounds, was conveyed from the field of action to Tarragona.

The theatre of this conflict was confined to that district of Catalonia which is bounded by the Ebro, the Segre, and the Lobrigat Rivers. The most northern point of action was Vals, and the southern extremity at which the French appeared was Lapoblar. Tarragona, to which the Spaniards retreated, is on the coast. In these circumstances the French have nothing to oppose their progress through the extensive and luxuriant meadows of Valencia.

General Reding is since dead, and has been succeeded in his command by General Blake, who had at Tortosa an army of 20,000 well organized infantry, and about 1000 horse.

Previous to the 30th April, the French are said to have retired from Barcelona, excepting a small garrison in the Citadel (Montjuich). It is also said that the forces which had left that neighbourhood with their plunder and prisoners, on their return, as is supposed, to France, had suffered severely near Vique from the Catalans. One detachment had been cut off entirely, and many carried back wounded to Barcelona.

In the north, early in March, the Marquis de la Romana, leaving Chares, proceeded along the eastern boundary of Galicia, and reached Villafranca, one of the defiles communicating between Leon and the adjacent maritime province. His army at that time consisted of about 14,000 men. The nephew of the Marquis commanded a small detachment of light troops, consisting only of 200 men, with which he has, in a great variety of skirmishes, much harassed the enemy. In

one of these he had the good fortune, among others, to make the French General Moncet prisoner.

From the successes against the enemy in the province of Galicia, Vigo surrendered to the Patriots, who were ably supported by two British frigates, then in the bay. This event occurred on the 28th, after which the French garrison was embarked to the number of 1300, and 300 were left in the hospitals. The indignation of the Spaniards was so powerfully excited that the French were indebted for their lives to the interposition of the crews of our ships of war.

The enemy had abandoned the town and defiles of Villafranca on the approach of General Romana, and about the middle of the month his army was distributed between Lugo, in Gallicia, and Oviedo, the capital of Asturias. A part of this army, impatient of inactivity, had descended from the northern mountains to the extended plain called El Vierzo, on the eastern bank of the River Tuerta, and equi-distant from the defiles of Villafranca, and the city of Astorga.

The Marquis, after taking the route already described in Asturias and Leon, suddenly advanced with the main body of his army eastward to St Jago de Compostella, which is about sixty miles south of Corunna, while a division proceeded through the vale of Mandeo to the neighbourhood of Betanzos, within 20 miles of that port. By these movements all means of intercourse between Ney the Duke of Elchingen at Corunna, and Soult the Duke of Dalmatia at Oporto, were obstructed, and both Corunna and Ferrol were threatened.

Soon after this, the enemy attacked him, but was repelled with great slaughter, and lost a quantity of artillery, and a great deal of specie, plate, and other valuables.

Vallasteros also made a successful attack on the French, very beneficial in its consequences, and highly honourable to Asturian courage; made 150 prisoners, among whom are four officers; and took some artillery. Six hundred of the enemy were left dead on the field.

About the same time, Joseph Bonaparte retreated from the capital.

The French, however, again entered Asturias on or about the 17th of May. In the confidence of security, the defiles on the frontiers of this province had been abandoned, both by the army of the Commander-in-chief, the Marquis de la Romana and by the forces under the General of the District, D. Francisco Vallasteros. The Marquis was at Oviedo organizing the civil Magistracy, when he received a dispatch acquainting him with the approach of the enemy. Thence General Romana

proceeded to Gijon, where he embarked with four Aides de-Camp, in the Palamo sloop of war, and set sail for the western coast of Gallicia.

The state of General Vallasteros was thus rendered very critical. On the 6th of May, he was in the eastern extremity of Asturias.

Extraordinary activity had been employed to collect the Reserve of Conscripts in the South of France, and they had poured in a torrent into Spain. It is supposed that these new levies compose the garrisons of Montjuich, Figueras, and Pamplona, and that the veterans who occupied those fortresses are sent westward, to the provinces of Leon, Asturias, and Gallicia, and of Tralos-Montes, in Portugal.

About the 10th of May, Ney was at Corunna, and had about ten thousand men under his command. From this body a detachment proceeded towards Lugo to attack the army of Romana, which was supposed to be in that neighbourhood. This marshal had, at that time, no communication with Soult, and had known nothing for a long time respecting him, all the French messengers having been intercepted by the peasantry. There were only about 2 or 3000, one account says 700, French soldiers at Ferrol, that town being considered in a sufficient state of security with a small force, from the commanding situation of the garrison. Marshal Ney had dismantled the forts and heights, and had removed from St Lucia all the guns as a measure of precaution. Corunna was very deficient in provisions, and forage for the cavalry was not to be obtained without great difficulty. In consequence of the opposition of the peasantry, a quantity of provender had been intercepted on the shores of Mandeo, and to revenge this act of hostility, a strong party of French was dispatched towards Villalva under Fournier, who was repulsed, and in the malignity of his feelings resulting from the disappointment, he destroyed 16 villages. At Vigo, the people were in a state of the lowest misery, from the oppression and violence to which they had been exposed, and on account of the privations they had suffered, the diseases incident to a deficiency of nourishment, had made considerable ravages among them.

It was generally reported, that in the beginning of June all the north of Spain was evacuated by the French, but no confidence was reposed in its accuracy. The natives, however, had taken possession of the town and port of Santander.

In the capital, great dissensions are said to prevail in Joseph's cabinet of Spanish ministers. All the money and plate that could be collected at Madrid, were sent to France by the generals, so that Joseph and his court have been left in a state of the greatest penury, and have no answer to those who have claims upon them for the smallest sums, but that they shall receive payment when the money ships arrive from America. The timidity of Joseph's character has been brought so much into view by the situations into which he has been thrown since he came into Spain, that he will never be able to efface the impression which it has made on his countrymen, or secure their good opinion. On the first alarm of danger, he is sure always to recommend flight.

His partizans praise the mildness and humanity of his character, and urge their countrymen to submit to him quietly as their sovereign, least their resistance should provoke Bonaparte to take the crown to himself, and annex Spain as a conquered province to the French empire. But notwithstanding this boasted mildness of character, a vast number of persons have been executed at Madrid since the capitulation of the city, for having taken part against his usurpation, after his flight to Vittoria. These executions are not confined exclusively to the peasantry and lower orders. Arriaza, who was secretary to the Spanish Legation in London before the rupture in 1804, was condemned to be shot, for a copy of verses which he wrote in last September, in commemoration of the battle of Baylen and other successes of his countrymen. To infuse terror also into those whom hypocrisy could not deceive, a marquis invested with the honourable habit of Santiago, who had been conspicuous for his attachment to his lawful sovereign, had also been seized and hung, and his corpse was publicly exposed on a lofty gibbet.

It is satisfactorily ascertained, that soon after this, King Joseph retreated to Burgos. In the Castiles, the natives rose upon the enemy. The French, who intended to reinforce Ney, consequently abandoned their design, and retired to Benavente, and Valencia de St Juan. Those who were in the city of Leon were also withdrawn.

Previously, however, to this, Joseph Bonaparte signified his wish that deputies should meet from both parties, to confer on the means of preventing that ruin and desolation in the

south, which had involved in misery the north of Spain. This ostensible reason was, however, obviously intended to conceal the true one, namely, in the present weakness of the French armies, to gain time until the war in Austria should be terminated; but, in this instance, the Central Junta displayed that integrity, courage, and independence, in the exercise of their exalted duties, which is worthy the dignity of the Spanish name.

PORTUGAL.

Early in March, General Beresford was appointed Field-Marshal in Portugal by the Prince Regent, and Generalissimo of his forces. It was his object to organize the Portugueze army.

Upon the approach of the French vanguard to Braga, the armed inhabitants of that city waited upon the Portuguese general, B. Frere de Andrade, in great numbers, offering to advance and meet the French force. He refused, alleging, it would be the height of madness to attack them in the passes; but that he had provided every thing, and would give them battle. The great number of people from the country, who hourly joined the citizens from all parts, and the rapid advance of the French, caused the peasants to be exceedingly clamorous, nay, furious; but the general even refused ammunition to those who had fire arms. At this crisis, it was discovered that even the Portuguese troops were without cartridges, which caused so great a ferment among the multitude of pikemen, that they attacked the general and guards. A desperate conflict ensued, when the peasantry forced the house, and instantly killed the general and his aid-du-camp, by cutting them in pieces. One of the secretaries, who survived a short time, after receiving several stabs, called for mercy, and entreated permission to make a full disclosure, and pointed out the places where the ammunition was secreted and buried, together with two papers, which fully proved that the general had agreed with the French commander to admit 30,000 troops, in three divisions, into Portugal. The terms, &c. were fully proved. In consequence of which the Marquis Lola, and three other noblemen, commanders of the forces, were seized and sent prisoners to Lisbon. The star, &c. of the general was embrued in blood, as a mark of triumph over perfidy. In consequence of this discovery, the rage and frenzy of the people was unrestrainable. They sallied to meet the French, and a hasty and terrible conflict ensued: the Portuguese completely destroyed

the first advance of 500 French cavalry; with the second division they equally succeeded, and more than 500 horses were captured, and sent to Oporto. Among the prisoners taken were numbers who formed part of Junot's army. This spirited conduct of the peasantry of Braga has caused universal joy, and we hope will be productive of similar emulation.

On the 10th of March, an engagement took place in Sante Andre, between the Portuguese troops and the French. The Portuguese behaved with the utmost gallantry, and the enemy's loss was very severe. People who witnessed the action state, that the French employed from 10 to 12 waggons to carry off their wounded.

The French were also a second time defeated near Braga. A second attack being made upon the enemy, a great number were killed and wounded, and 500 cavalry, with their horses, were taken. The men dismounted from their horses, and endeavoured to escape by leaping into the river Cavado.

On the 26th, the enemy appeared, to the number of 6000 infantry, and 500 cavalry, in three columns, and assembled at Cividad Rodrigo, where were posted some Spaniards and a Portuguese legion, with whom there was skirmishing during the whole of that day and the following night. The intention of the French appeared to be to attack Praza, as they brought many ammunition waggons laden with cords and ladders. On the 27th, however, a sally was made from Praza, supported by artillery, and commanded by Algarve, and they rushed with so much fury upon the enemy that he thought fit precipitately to retire.

In April, Marshal Soult finding his situation dangerous at Oporto, on the approach of the army of General Silveira, passed the Vonga, and traversing the entire province of Beira, pushed forward to Coimbra, on the shores of the Mondego.

An intercepted letter from General Kellerman to Marshal Soult, proves at this time the embarrassed situation of the French armies in Spain, and the anxiety and fears entertained by the French Generals in that country, in consequence of the commencement of hostilities with Austria.

The British Commander did not reach Oporto till the 12. of May. On the 28th and 29th of April, however, Soult's advanced guard attempted to carry the bridge of Amarante over the Tamega; but were repulsed by the Portuguese force under Silveira, with which the legion of Sir Thomas Wilson had been previously united. . . The attack is said to have been renewed on the 1st, without success; but on the 2d, Marshal Soult, having by that time collected his whole force, suc-

ceeded in carrying the bridge. He directed his march, though in great disorder, to Gallicia.

Some skirmishes and an action were soon after fought with the enemy by the British under Sir Arthur Wellesley, in which both the Officers and men belonging to our army were distinguished by their uniform and characteristic bravery.

Marshal Soult now altered the direction of his retreat, and instead of proceeding towards Tralos Montes, fearful of meeting with General Beresford, and the force in the vicinity of Chaves, he proceeded north, towards Gallicia.

He, at last, effected his retreat into Gallicia, but not without serious loss. His artillery, baggage and ammunition were sacrificed.

Sir Arthur Wellesley however returned from the pursuit, in consequence of the advance of Victor's Corps towards Lisbon. It would seem as if Soult's retreat had been a feint to draw the English after him, so as to open the way for the Duke of Belluno to attack the capital of Portugal. Marshal Victor then fell back from Alcantara, whether general MacKenzie was rapidly advancing, supported by Sir Arthur, who had passed the Mondego. Victor had taken the road of Caceres and Truxillo, which are in the direction of Madrid, abandoning his former encampment at Merida. Cuesta was advancing from Monasterios upon Medelin.

AUSTRIA.

DECLARATION OF WAR, BY FRANCIS I. EMPEROR OF AUSTRIA.

"Francis I. by the Grace of God, Emperor of Austria, &c.

"People of Austria!—"I leave my capital to join the brave defenders of the country, assembled on the frontiers for the protection of the State.

"For three years past, I have made the utmost exertions to procure for you, my beloved subjects, the blessings of a permanent peace. No sacrifice, any way consistent with your welfare and with the independence of the State, however painful, have I spared to secure your tranquillity and welfare, by a friendly understanding with the Emperor of the French.

"But all my endeavours proved fruitless. The Austrian Monarchy was also to submit to the boundless ambition of the Emperor Napoleon; and in the same manner he strives to sub-

due Spain, insults the sacred Head of the Church, appropriates to himself the provinces of Italy, and parcels out the German dominions. Austria was to do homage to the *great empire*, the formation of which he has loudly announced.

" I have adopted all necessary measures to assert the independence of the State. Not only have ye answered my call, but your love for your native country has prompted you to anticipate it. Accept my cordial thanks; they will be repeated by my posterity and by yours. Self-defence, not invasion, was our aim. But the conqueror will not allow the sovereign of his people, strong in their mutual confidence, to possess sufficient means to oppose his ambitious views. He declared himself hostile to Austria, unless she should relinquish her measures of defence, and prostrate herself disarmed at his feet. The disgraceful proposal was rejected, and now his hosts are advancing against us, arrayed for battle.

" I confide in God; in the valour of my armies; in the heroic conduct of my brother, who leads them on to glory; in you, my beloved people. Our exertions for this warfare are great; but such they must be in order to attain more securely the important end of self-preservation.

" What you have hitherto done is the most unquestionable pledge of the powerful assistance which I am to receive from you. They who bear no arms will also share in the protection of their country. Unanimity, order, obedience, activity and confidence constitute the real strength of a nation. You have evinced them, and to this alone is it owing, that we start with a fairer prospect of success than we ever did. Fortunate events will not unnerve your energy, nor disastrous occurrences, should any happen, shake your firm resolve. Persevering valour overcomes all dangers, enhances every advantage, and supplies all losses. Our cause is just; Providence does not forsake those who do not forsake themselves.

" I depend on your love; your tried fidelity to your Prince and Country. Depend ye on the paternal solicitude of your Monarch, who finds all his happiness in yours.

" *Vienna*, *April* 8, 1809." " FRANCIS."

The court of Vienna, at the same time, published a heavy pamphlet, in the shape of a manifesto, against France. It contains a long enumeration of grievances, from the peace of Presburg down to the period of the present rupture, the heads of which are, 1st, That the articles of the treaty of Presburg in favour of Austria, were either not carried into effect at all, or only after arbitrary and disadvantageous alterations, while

all the conditions favourable to France were executed to the full extent within the time prescribed. 2d, That fresh contributions were levied after all the arrears of military requisitions were paid, and effects belonging to the Emperor seized, to the value of 24,000,000 florins, without making the stipulated compensation. 3d, That a passage was peremptorily demanded by France for her troops, from the Venetian States to the provinces on the east coast of the Adriatic, through the Austrian territory. 4th, That the Austrian territory, on the right bank of the Izonga, was refused to be evacuated, on the frivolous pretence of the procrastinated surrender of Catarro, for which the French plenipotentiaries were alone to blame. 5th, That the German constitution was violently overthrown, and the Emperor unjustly spoiled of his dignity. The paper then proceeds to state the strict neutrality observed by Austria, in the war between France and Prussia, and her acquiescence in the peace of Tilsit, though several of the articles, and the whole tenor of the treaty, were manifestly prejudicial to her interests.

The Archduke Charles also issued the following

ADDRESS TO THE GERMAN NATION.

" His Majesty the Emperor of Austria is forced to take up arms, because the French Emperor will not tolerate the existence of a state which does not acknowledge his supremacy of power, nor stoop to become subservient to his views of conquest; because he requires that Austria shall renounce her independence, unbend her energies, and surrender at the Conqueror's discretion; because the armies of the Emperor of France, and of his dependent allies, advance against Austria with hostile views.

" The forces of Austria have risen for self-defence and self preservation at the nod of their Monarch; I am leading them on against the enemy, to prevent the certain attack he has prepared against us.

" We pass the frontiers not as conquerors; not as enemies of Germany, not to destroy German institutions, laws, customs, and manners, and impose foreign ones; not to appropriate to ourselves the property of Germany, or to sacrifice her children in distant wars, carried on to destroy and subjugate foreign nations. No; we fight to assert the independence of the Austrian Monarchy, and to restore to Germany the independence and national honours which are due to her.

"The same pretensions which now threaten us have already proved fatal to Germany; our assistance is her last effort to be saved. Our cause is that of Germany. United with Austria, Germany was independent and happy. It is only through the assistance of Austria that Germany can receive happiness and independence.

"Germans! Consider your destruction. Accept the aid we offer, and co-operate with us for your salvation. We demand from you no exertions, but such as the war for our common cause requires. Your property and your domestic peace are secured by the discipline of our troops. The Austrian armies will not oppress, nor rob you; they respect you as brethren, chosen to fight jointly with us, for your cause and for ours. Be worthy of our respect; such Germans only as forget themselves are our enemies.

"Depend on my word, which I have more than once pledged, and redeemed, to save you! Depend on the word of my Emperor and brother, which has never been violated.

"CHARLES, Generalissimo."

ADDRESS OF THE ARCHDUKE CHARLES TO HIS TROOPS.

"The protection of our country calls us to new exploits. As long as it was possible to preserve peace by means of sacrifices, and as long as these sacrifices were consistent with the honour of the throne, with the security of the state, and with the welfare of the people, the heart of our bountiful Sovereign suppressed every painful feeling in silence; but when all endeavours to preserve happy independence from the insatiable ambition of a foreign Conqueror prove fruitless, when nations are falling around us, and when lawful sovereigns are torn from the hearts of their subjects, when, in fine, the danger of universal subjugation threatens even the happy states of Austria, and their peaceable fortunate inhabitants; then does our country demand its deliverance from us, and we stand forth in its defence.

"On you, my dear Brother Soldiers, are fixed the eyes of the universe, and of all those who still feel for national honours and national prosperity. You shall not share the disgrace of becoming the tools of oppression. You shall not carry on the endless wars of ambition under distant climes. Your blood shall never flow for foreign fleets and foreign covetousness; not on you shall the curse alight to annihilate innocent nations; and over the bodies of the slaughtered defenders of their coun-

try to pave the way for a foreigner to an usurped throne. A happier lot awaits you; the liberty of Europe has taken refuge under our banners. Your victories will loosen its fetters; and your brothers in Germany, yet in the ranks of the enemy, long for their deliverance. You are engaged in a just cause, otherwise I should not appear at your head.

"On the fields of Ulm and Marengo, whereof the enemy so often remind us with ostentatious pride, on these fields will we renew the glorious deeds of Wurtsburgh and Ostrach, of Liptingen (Stockach) and Zurich, of Verona, of the Trebbia and of Novi. We will conquer a lasting peace for our country. But the great aim is not to be attained without great virtues. Unconditional subordination, strict discipline, persevering courage, and unshaken steadiness in danger, are the companions of true fortitude. Only a union of will, and a joint co-operation of the whole, lead to victory.

"My Sovereign and Brother has invested me with extensive powers to reward and to punish. I will be everywhere in the midst of you, and you shall receive the first thanks of your country from your General on the field of battle. The patriotism of many of the Austrian nobility has anticipated your wants: this is a pledge, in the fullest measure, of the public gratitude: but punishment shall also, with inflexible rigour, fall on every breach of duty: merit shall meet with reward, and offence with animadversion, without distinction of person or rank. Branded with disgrace shall be the worthless person to whom life is dearer than his or our honour: adorned with the marks of public esteem, will I present to our sovereign, to the world, those brave men who have deserved well of their country, and whose names I will ever carry in my heart.

"There remains one consideration, which I must put you in mind of: the soldier is only formidable to the enemy in arms; civil virtues must not be strangers to him: out of the field of battle, towards the unarmed citizens and peasants, he is moderate, compassionate and humane: he knows the evils of war, and strives to lighten them. I will punish every wanton excess with so much greater severity, as it is not the intention of our Monarch to oppress neighbouring countries, but to deliver them from their oppressors, and to form with their Princes a powerful bond in order to bring about a lasting peace, and to maintain the general welfare and security. Soon will foreign troops, in strict union with us, attack the common enemy. Then, brave companions in arms! honour and support them as your brothers: not vain-glorious high words but man-

ly deeds do honour to the warrior: by intrepidity before the enemy you must shew yourselves to be the first soldiers.

"Thus then shall I one day lead you back to your own country, followed by the respect of the enemy, and by the gratitude of foreign nations, after having secured by your arms an honourable peace, when the satisfaction of our Monarch, the approbation of the world, the rewards of valour, the blessings of your fellow citizens, and the consciousness of deserved repose await you.

CHARLES, Archduke, Generalissimo."

It was however a most fatal error in the Austrians to divide their forces into three separate armies at the beginning of the campaign. After the defeat in Bavaria, of what importance was it for them to have penetrated on the one side to Warsaw, and on the other to Vicenza? This unfortunate mistake has, as will be seen, been productive of irremediable evils.

Hostilities commenced on the 10th of April, when the Austrian army crossed the Bavarian frontiers. In consequence of this movement, which was announced to the King of Bavaria by the Archduke Charles, the former removed from his capital to Dillingen, a town on the Danube, between Ulm and Donauwerth, the Austrian army advanced by the way of Landshutt to Munich.

On the 19th, 20th, 21st, 22d and 23d, no fewer than six actions were fought, in all of which the Austrians were defeated; the result of which was, that between the 19th and 27th, they lost 50,000 prisoners, 100 pieces of canon, with an immense quantity of colours and baggage. They retreated about 150 miles. At Ratisbon, the Archduke Charles obtained some success on the 21st, and forced 1000 French, who were entrusted with the care of the bridge, to surrender; but this gleam of prosperity was of short duration, his army, consisting of 110,000 men, having been completely defeated on the following day; in consequence of which he was obliged to retire into the mountains of Bohemia. Davoust, duke of Auerstadt, went in pursuit of him. In the mean time, the main body of the French army rapidly advanced towards the capital—Victor, the duke of Belluno, having passed the Salza, occupied Scharding, a village about eight or ten miles from Brannau, and situated on the road between Passau and Linz. Scharding is about half way between Augsbourg (where hostilities began) and Vienna.

Such was the progress of the enemy in the first week of the campaign! This, however, was the most advanced corps of the

French army. Their head-quarters on the 27th were at Muhldorff upon the Inn; but Lannes, (duke of Montebello), had then passed that river, and was proceeding to the Salza. The Marshals who had a share in the several actions were Massena (duke of Rivoli), Davoust (duke of Auerstadt), Lefevre (duke of Dantzig), Lannes (duke of Montebello), and Bessieres (duke of Istria). Marshal Kellerman (duke of Valmy), commanded the reserve; and Marshal Bernadotte (Prince of Ponte Corvo) had not then reached the scene of action. The Austrian army, previous to the battles, was estimated at 220,000 men, 110,000 of whom were commanded by the Archduke Charles, and 60,000 by the Archduke Louis. Generals Hohenzollern, Lichtenstein, Rosenberg and Bellegarde, had the command of corps, and that of General Bellegarde is said to have been the only one not in action.

Bonaparte, on the late occasions, succeeded by the same manœuvre, which have, in so many instances, led to similar results. He attacked one corps after another of the Austrian army with the same troops, always bringing a superiority of numbers to bear against those opposed to him, and thus, with a force perhaps inferior upon the whole, reaped, by means of tactics, all the advantage of the most decided pre-eminence in point of strength. In Spain, he beat the army of Blake in Biscay, of Estramadura at Burgos, and of Castaños at Tudela, with the same force, merely by rapidity of movement. And now, in Bavaria, he began with destroying his adversary's left wing under the Archduke Louis, and afterwards defeated the centre under the Archduke Charles, with the very same troops.

It would also seem that there has been a great want of concert between the different members of the Austrian army, otherwise this would not have been practicable, or certainly could not have been so easily accomplished. The Archduke Louis appears to have received no support from the Archduke Charles. In consequence of the defeat of the latter, the left wing of the former was left exposed, and meditating an attack, its commander was forced upon his defence, in circumstances where he was deprived of the co-operation of one whole corps of his army—that of Bellegarde, which passed Ratisbon after the battle. Had the wing under the Archduke Louis fallen back upon the first appearance of the enemy, and the French gone in pursuit, the Archduke Charles, by coming down upon their rear, might have brought their whole army into jeopardy.

The Archduke Charles also, after the battle of the 22d, committed a great fault in leaving six regiments by way of

garrison in Ratisbon, which, though surrounded by an old wall and ditch, must, in every military view, be considered as an open town. This was bad in two ways. Ratisbon was taken by assault, and these six regiments were sacrificed, though they had not even taken the precaution of destroying the bridge; and great calamity was thus also necessarily brought upon the inhabitants, without being of the smallest service to the party exposing them to it... It is a complaint which has been often made against the Austrians, that by attempting to defend open towns, they do themselves no good, while they do infinite mischief to the unoffending population, which every maxim both of humanity and policy ought to induce a belligerent to spare.

The Archduke Charles, so late as the 28th, was still at Cham, and at that time was joined by the corps of generals Belliegarde and Klenar, and also by a considerable force under the generals Norman, St Vincent, and Kienmayer, making his army to amount altogether to 150,000 men.

The French took possession of Vienna on the 12th, when Bonaparte issued a proclamation to the army, recommending to them to behave well to the inhabitants of the capital, and in general to the people of the country. It is easy to perceive, both from the style of this proclamation and of the bulletins previously published, that he has no intention of restoring to their sovereign the states which he has conquered.

It seems the Archduke Maximilian, who was entrusted with the defence of that capital, attempted to make some resistance to the enemy, in which the people refused to second him. The consequence of this attempt was, that the city was bombarded and set on fire. The Archduke, and the greater part of the garrison, secured their retreat into Hungary. The army of General Hiller retired towards the confines of Moravia.

Russia now declared against Austria; and the Russian minister left Vienna.

A division of the French army now also passed the Danube, and the war was carried into Moravia and Hungary. Bonaparte then declared that he was at war with the Emperor of Austria, not with the King of Hungary; and strove, by the most subtle means, to seduce that faithful people from their allegiance.

In Poland, the Austrians obtained, in the mean while, some successes; but any advantages gained in that remote quarter were not likely materially to affect the final result of the contest.

An insurrection also took place in Germany under Major Von Schill. The King of Westphalia, by a decree, declared him an outlaw, and offered 10,000 francs for his apprehension. Schill's party, however, seems to have acted without system or any definite object.

In the Tyrol the inhabitants, on the first appearance of an Austrian force, generally revolted against the Bavarians, and even succeeded in overpowering them. In a report upon the subject, made to the Emperor, by an Austrian Officer, dated on the 15th from Inspruck, their ardent zeal in the cause of their former Sovereign is described in the most animated and affecting merits. In the Tyrol, however, the French and Bavarians have been uniformly successful since the disasters at Ratisbon compelled the Archduke John to retreat, and left the Tyrolese at the mercy of their enemies.

Hostilities also began in Italy; and in the first affair which took place, though not of much importance, the Austrians were repulsed. The French head-quarters were at Campo Formio on the 12th, and the army was concentrating itself upon the Talgiamento.

In the Vienna Papers, however, we find an Austrian Bulletin, dated on the 7th, giving an account of an action, fought on the Piave by the Archduke John, against the Viceroy of Italy, in which the former seems to have had a decided advantage. This is obvious, even from the enemy's account of it.

The French head-quarters were at Treviso on the 4th of May, and the communication between Milan and Venice was said to be quite free; but the Austrians had never advanced far beyond the Piave.

General Macdonald, on the 17th, took Trieste; and on the 18th, 3000 Austrians laid down their arms in the Tyrol, and the division of General Seras took the strong post of Plast by storm, and formed a junction with the army of the Viceroy Eugene Beauharnois, at Jarvis.

AUSTRIAN OFFICIAL BULLETIN, OF THE DEFEAT OF THE FRENCH.

"In pursuance of the command of his Imperial Highness the Generalissimo, the following preliminary Report of the bril-

liant victory obtained on the 21st and 22d of May, was issued on the 23d, from the head-quarters at Breitenlec:—

On the 19th and the 20th, the Emperor Napoleon passed the greater arm of the Danube, with the whole of his army, to which he had drawn all the reinforcements of his powerful allies. He established his main body on the Island Lobau, whence the second passage over the less arm, and his further offensive dispositions were necessarily to be directed.

His Imperial Highness resolved to advance with his army to meet the enemy, and not to obstruct his passage, but to attack him after he had reached the left bank, and thus to defeat the object of his intended enterprise.

This determination excited throughout the whole army the highest enthusiasm. Animated by all the feelings of the purest patriotism, and of the most loyal attachment to their Sovereign, every man became a hero, and the smoaking ruins—the scenes of desolation which mark the track of the enemy in his progress through Austria, inflamed them with a just desire of vengeance. With joyful acclamations, with the cry, a thousand times repeated, of—"Live our good Emperor," and with victory in their hearts, our columns, at noon on the 21st, proceeded onward to meet the reciprocal attack of the advancing enemy, and soon after three o'clock the battle commenced.

The Emperor Napoleon in person, directed the movements of his troops, and endeavoured to break through our centre with the whole of his cavalry: that vast body of horse he had supported by 60,000 infantry, his gaurds, and 100 pieces of artillery.—His wings rested on Aspern and Eslingen, places, to the strengthening of which, the resources of nature and of art had, as far as was possible, contributed.

He was not able, however, to penetrate the compact mass which our battalions presented, and every where his cavalry shewed their backs, while our cuirassiers unhorsed his armour equipt cavaliers, and our light horse carried death into his flanks.—It was a gigantic combat, and is scarce capable of description.

The battle with the infantry became immediately general. More than 200 pieces of cannon exhibited on the opposite sides, a rivalry in the work of destruction. Aspern was ten times taken, lost, and again conquered. Eslingen, after repeated attacks, could not be maintained. At eleven at night, the villages were in flames, and we remained masters of the field of battle. The enemy was driven up in a corner, with

the Island of Lobau and the Danube in his rear. Night put an end to the carnage.

Meanwhile fire-boats, which were floated down the Danube, destroyed the bridge which the enemy had thrown over the principal branch of the river. The enemy, however, conveyed over during the night, by continued embarkations, all the disposable troops which he had in Vienna and on the upper Danube, made every possible effort for the re-construction of his great bridge, and attacked us at four in the morning, with a furious cannonade from the whole of his artillery, immediately after which the action extended along the whole of the line. Until seven in the evening, every attack was repelled. The perseverance of the enemy was then compelled to yield to the heroism of our troops, and the most complete victory crowned the efforts of an army, which, in the French Proclamation, was declared to be dispersed, and represented as annihilated by the mere idea of the invincibility of their adversaries.

The loss of the enemy has been immense; the field of battle is covered with dead bodies, from among which we have already picked up 6000 wounded, and removed them to our hospitals.

When the French could no longer maintain themselves in Aspern, the brave Hessians were obliged to make a last attempt, and were sacrificed.

At the departure of the courier, the emperor Napoleon was in full retreat to the other side of the Danube, covering his retreat by the possession of the large island of Lobau. Our army is still engaged in close pursuit.

The more particular details of this memorable day shall be made known as soon as they are collected.

Among the prisoners are the French general Durosnel, general of Division, and Foulet Reyer, first chamberlain to the Empress; also the Wurtembergh general Roder, who was made prisoner at Nusdorf by the second battalion of the Vienna Landwehr."

The French army of Italy, however, effected its junction with the army of Germany, on the 26th ultimo, at Bruck. In consequence of this event, Buonaparte published, from his head-quarters at Ebersdorff, on the 27th, a proclamation, in which he recounts the exploits of his Italian army, and compliments it upon its success.

Stralsund was, about the same time, taken by the Dutch, after a most sanguinary conflict in the streets of that town, in

which Major Schill, who had previously occupied it, was killed, and one third of his corps were put to the sword.

The French in the mean-time considerably enlarged their *tete de pont*, which put it in their power to repass the river as as soon as they found it convenient. The Archduke Charles also caused a *tete de pont* to be erected on the right bank of the Danube, opposite to Presburgh, which was three different times attacked by Marshal Davoust, without success, though it was defended only by the troops of the Landwehr, or national militia.

About this time the Russian army, crossed the frontiers on its way to Olmutz. This advance of the Russian army into Moravia, must have operated as a strong inducement to the Archduke to forego the advantages, which, under other circumstances, he might have derived from a system of protracted warfare.

The Tyrolese meanwhile took Kufstein, made an irruption into Bavaria; and penetrated within 12 miles of Munich: the Austrians also got possession of the capital of Saxony. This gave them the command of a country rich in grain, and from which they might draw exhaustless stores of provisions for their army; and, by enlarging the sphere of their protecting force, held out encouragement to those who were well affected to their cause distinctly to pronounce in their favour, and erect a standard around which insurgents from all quarters might rally.

At this time, it appears that the corps of Marshal Davoust, supported by a division of the army of Italy, formed the right wing of the French; Massena's corps, which occupied the islands on the Danube, together with that of General Oudinot, and the cavalry under Bessieres, constituted the centre; while Bernadotte's force, composed principally of auxiliaries, was posted on the left wing. Generals Macdonald and Marmont prepared to march into Hungary, and Duke D'Abrantes to take the command of an army of reserve upon the Rhine; while Marshal Kellerman was, with a scattered force, endeavouring to overawe the insurgent districts of Germany.

ITALY.

Under this head, there is only to be remarked, that Bonaparte has not scrupled to annex the papal territory to France. This annexation, however, was extremely imprudent, at a time when he was contending with the two nations of Europe the most strongly attached to the head of the catholic church.

SWEDEN.

In this country, a revolution has been completed in as short a period as the former, by the father of the present king, in 1772, and, like its precursor, without the death of a single adherent of the court or the insurgents.

The following circular letter, addressed to the Public Boards, Courts of Justice and Consistories, was issued:

"Charles, by the grace of God, &c. ours, &c.

"Whereas, in consequence of the events which have lately taken place, his Royal Majesty is not able to superintend and direct the affairs of the realm, therefore, we being the only prince of the royal family who is of age, have found ourselves moved to assume, until further notice, the reins of government, and shall endeavour to acquit ourselves of the arduous task in such a manner, that the empire may regain its former tranquillity and peace both abroad and at home, and that trade and industry may be revived; it being our firm determination to deliberate jointly with the other states of the realm, on the means which shall appear best calculated to promote the welfare of the Swedish people; we therefore charge and command you to evince towards us that fidelity and attachment which our sincere way of thinking, and the sincerity of the country demand at the present time. Your official reports are to be addressed to his Royal Majesty in the same manner as when, during the minority of the king, we presided over the management of the concerns of the state, &c.

"CHARLES M. ROSENBLAD."

Stockholm Castle, the 13th March, 1809.

The king was, early in March, removed under a strong escort from Dortringholm to Gripsholm, a palace about 45 English miles from Stockholm, kept closely confined, and not permitted to see the queen.

At the same time, about 600 Cossacks, who had come over from Aland to Greslehamm, being a part of the army who had taken the former island, were on their march to Stockholm, when they were met by a flag of truce, in the name of the Duke Charles—An armistice was immediately signed, to wait the Emperor of Russia's answer.

The terms on which he consented to negociate were the cession of Finland, the exclusion of the British shipping from

the Swedish ports, and the re-establishment of a legitimate government. Even this, however, was not to be settled until he received an answer from Paris to a communication made to the French government on the subject.

Early in May, the Swedish diet determined upon the formal dethronement of Gustavus Adolphus and his posterity, and upon bestowing the diadem on the Duke of Sudermania (under the title of Charles XIII.), who is to appoint his own successor. The regent also announced his acceptance of the crown of Sweden, and of the Goths and Vandals.

Russia, however, not being satisfied with the decision of the diet, in favour of the Duke of Sudermania, recommenced hostilities against Sweden.

The regency of Sweden has, meanwhile, expressed a hope that the British government will not, at least for some time, withdraw the subsidy which we were bound to pay to that country during the war. Of the impolicy of granting this subsidy in the first instance, it has justly been observed, that *now* little doubt can be entertained. By enabling the King of Sweden longer to persevere in hostility with his neighbours than he would otherwise have had the means of doing, it may be considered as the principal cause of his dethronement. But, however impolitic and however cruel it might be, in the first instance, to grant a subsidy to Sweden, which every person of the smallest foresight clearly perceived must have the effect of ruining that unfortunate country, it by no means follows, now that the dreaded crisis is come, that we should leave it unpitied and unassisted. On the contrary, a sense of having been instrumental in reducing it to the helpless and forlorn state in which it now lies ought to stimulate us to do every thing in our power to repair past wrongs, and to alleviate, at least in some degree, the distresses in which it is involved in consequence of its connection with this country. All accounts agree in representing the internal situation of Sweden to be deplorable beyond the power of language to express: this misery is entirely consequent upon the war; and when it is considered that this war has been carried on in concert with Great Britain, if not at her instigation, no liberal—no just mind we are sure can reject the inference—that we are bound by duty, honour, and every feeling which render either individuals or societies respectable, to administer to the relief of her wretched population to as great an extent as our own pressing wants and exigencies will permit us to attend to the claims of others.

RUSSIA.

Russia, in the present state of Europe, cannot be considered as an independent power.

General Prince Gallitzen, who commands the Russian army now advancing against Austria, announces to the people, that he is marching into their country with hostile intentions against their sovereign, determined to repel force by force, and enjoins them to remain quiet, as having no interest whatever in the conflict, in which case they will only change matsers, and will become the vassals of the Emperor of Russia, instead of being the subjects of Austria. This is precisely the same course which was pursued by his court in Finland, where all the ties which bind one government to another were as wantonly violated, and the principles of civil and social honour as grossly outraged and trampled upon, as they ever have been by any of the revolutionary or military governments to which France has given birth.

It has justly been considered as strange that a sovereign, avowedly acting upon such a system, should have been so long considered by the ministers of this country, not as an object of severe and exemplary castigation, but as calling for a display of conciliation, and long-suffering indulgence. As soon as the court of Petersburg avowed its subserviency to France, it became the duty and the policy of the British ministers to shew, by a vigorous system of warfare, what it had lost by changing its relations; and that the advantages of a French alliance were by no means sufficient to counterbalance the disadvantages of British hostility. But, instead of this, they have played with her sovereign as if he had been a froward boy, or rather a pettish girl; and now they rest all their hopes upon the chances of a conspiracy!

DENMARK.

The Danes have retaken a small island in the Baltic, of which we had taken possession, and an unsuccessful attack has been made by the English upon Erthholm and Bornholm.

UNITED STATES OF AMERICA.

The act repealing the embargo, and substituting for it the interdiction of all commercial intercourse between the United

States and Great Britain and France, and their dependencies, passed into a law of the United States, on the 1st March last.

It has been announced that the Orders in Council are rescinded, as far as they relate to the American Republic. It has also been decided, that the ports of France, Holland, Italy, and their dependencies, shall be put into vigorous blockade. Under the last distinction are to be included, in Spain, the city of Barcelona, and the bay of Rosas in the Mediterranean, and the coast of the bay of Biscay from Santander to Fonterabia. By this regulation the United States may trade without interruption from British cruizers, with all the ports of Russia, Norway, and Sweden, in the Northern Ocean; with the whole circuit of the Baltic Sea; with the British Isles; with Spain from the eastern extremity of Asturias to the southern bank of the Lobregat; and, Italian and French ports excepted, with every harbour of the Mediterranean, from the Straits of Gibraltar to the Sea of Marmora.

Licences are to be granted to all the ports north of the Weser and south of the Eyder; but we understand they are to be withheld with respect to the rest of the continent, excepting the havens of the Baltic.

Another commercial arrangement of great temporary importance, is the indulgence to be given as to the shipping to be employed in the transport of American produce. These commodities may be imported in any ship however documented, from the Floridas, from the Western Isles, from Madeira, Lisbon and Cadiz, free of the duties from the Orders in Council, to the 1st of August next.

SPANISH AMERICA.

Ferdinand the Seventh has been proclaimed in Lima, where the emissaries of Napoleon had been received four hours before the Marquis of Somernelos arrived with dispatches from the legitimate government. As soon as this Nobleman appeared, the embarrassment which was occasioned by the intrusion of the embassy of Bonaparte subsided. The sum of 16 millions of dollars, in specie, was collected to be remitted home, one fourth part of which was composed of voluntary contributions.

The city of St Jago, in the island of Hispaniola, has surrendered to the patriots, who were assisted in their enterprise to reduce the place both by the mulattoes and negroes. All the accounts shew the enthusiasm of the inhabitants of Hispa-

niola in favour of the parent country, and we think that, in a very short interval, the French will be expelled from it.

A revolution took place at Buenos Ayres, on the 1st of January, in which Liniers triumphed, and became completely master, as Viceroy, of the city.

Later accounts, however, announce the happy event of the total defeat and submission of Liniers to the patriotic party, who had established a Junta, proclaimed Ferdinand VII, and forced Liniers to sign a declaration that he would surrender the government on the arrival of the person appointed to succeed him.

THE BRAZILS.

The trade of Rio Janeiro, and the other great ports throughout the vast extent of the coast of the Brazils, continued in the same inactive condition. Six ships only had been allowed to pass from thence to Monte Video, and unload their cargoes; and, notwithstanding the attachment of the governor to Great Britain and her allies, this concession was not in future to be made, and the old system of the total exclusion of foreign vessels was to be rigidly adhered to.

FRANCE,

As the preceding details show, has, in the course of a few weeks, added another kingdom to her empire.

BRITAIN,

Has conquered the island of Martinique in the West Indies.

CONDUCT OF THE BRITISH GOVERNMENT DURING THE PRECEDING EVENTS.

Ministers have certainly been most shamefully blameable in not availing themselves of the late singularly happy opportunity for attacking the most vulnerable points of the enemy's coast.

To the want of judgment and of energy in the admiralty,

also is to be ascribed the losses we have sustained in our trade both in Europe and in the East and West Indies.

To the inefficiency of the force sent to the Baltic last year, or to the improper distribution of it, may be, in a very great measure, if not entirely, ascribed the late convulsion in Sweden and the deposition of his Swedish Majesty.

Had there been only a fire-ship sent under Sir Samuel Hood's orders, and attached to the Swedish fleet, the Russians might, upon their first entering Rogerwick, have been destroyed; and there is scarcely also a shadow of doubt that, had the Russian fleet in the Baltic been taken or destroyed, the Emperor Alexander would have been compelled to adopt an entire change of policy, and to return to those relations of peace, amity and alliance which he previously maintained.

With regard to affairs in Spain, it is certain that Admiral Cochrane would, with 5,000 men, and the command of a light squadron, have done more for both this country and its allies during the summer, than Sir Arthur Wellesley will atchieve with all his army, provided the system is not entirely altered.

It has been justly remarked, that the original character of the war in Spain, the method of defence first recommended by the Junta of Seville, and so universally approved of, and the actual circumstances of the contest, presented from the beginning, and still offer to the British government, the strongest inducements to this species of hostilities. We could not send a military force to Spain capable of driving the French out of the country. The Spaniards were disqualified, both by a deficiency of discipline and of equipment, from measuring their strength with a regular, experienced and well appointed army. In this situation, all they could do was to harrass and distress the enemy in every possible manner; and it evidently became our policy to second them in their efforts, and to co-operate with them in the only way that they were capable of acting at all. It so happens, therefore, that the only species of hostilities for which we are qualified—that species of hostilities for which we are indeed qualified far beyond all other nations, was also that which the character of the contest called for, and that alone which could be carried on with any effect. By simple demonstrations at one time in the North of Spain, at another in the South, and at a third on the coast of Portugal, inspiring the enemy with exaggerated notions of our strength by the velocity of our movements, we should have kept him perpetually

on the alert, annoyed and fatigued him by incessant marches from one quarter to another, and, with little loss to ourselves, granted far more effectual assistance to our allies, than by attempting to fight the French in pitched battles with not one third part of their force. And if, in the present circumstances of the conflict, when the French force in Spain is so much reduced (though not so far reduced as to be driven out of it by 25,000 British acting in a body), and while in France itself there are almost no regular troops, something be not done in this way, ministers ought, we shall not say, to lose their places, but to lose their heads.

It has with equal justice been observed that, not the least considerable evil attending ill managed expeditions, such as that we have lately sent to the Spanish peninsula, is, that the individual merits of distinguished and gallant officers are sunk in the general disgrace. Sent upon service, which no skill and no exertions on their part can bring to a successful issue, they return with the mortification of failure, and are hardly upheld by the consciousness of having done their duty. The late campaign, though truly calamitous to the country, exhibited a most noble display of military heroism on the part of the British army; and though, from the blundering incapacity of ministers at home, the commonwealth has derived no benefit from its prowess—though it may justly be said to have toiled and fought and bled in vain, its efforts and its sufferings have as strong a claim upon the public gratitude, as if they had been crowned with the most complete success. But, instead of being gratified by seeing a generous distribution of the fair and merited rewards of valour, what have we witnessed? Nothing but attempts to cavil at the conduct of the campaign, reflections against the dead, and insinuations against the living. Sir John Moore seems to be wholly forgotten, or remembered only as an object of insidious calumny. His family has not, as far as we know, received any mark of public sympathy on account of the distressing loss which it has sustained. And what is the tribute which has been decreed to Sir David Baird for his services in India, in Egypt, at the Cape of Good Hope, and at Corunna? He has been raised from the rank of Knight to that of Baronet! He has been elevated to the dignity, not unusually conferred upon some city cheesemonger, for a year's obsequiousness, to the minister of the day! This is the meed which his valour and his wounds have purchased! We put it to the generous feelings of the country, whether it is to be endured that its character should thus be stained with the appearance of the most

base and niggardly ingratitude. It is absolutely disgraceful to the nation, that its affairs should be conducted by men who are so insensible to merit, or who are so incapable of apportioning its fit rewards. For whom are ministers reserving the three red ribbands now vacant? For some ignorant and venial supporter of absurd and imbecile policy, or rather of men destitute of all policy. It is to support characters like these that we must contribute pensions, and create new honours. But for gallant men like Sir David Baird and General Hope, who bled in the field of battle, we must find something that is modest and cheap, something that costs little and is not worth much, in short, any thing that will save appearances.

The treaty of alliance, too, lately concluded with Spain, is perhaps one of the most extraordinary instruments which diplomacy ever produced. We had several specimens of Mr Canning's powers in bringing about and announcing the rupture of our pacific relations with other states; but this is his first effort in the way of conciliation, and a most clumsy, awkward and contemptible one it is. Let us attend for a moment to its date, its form, and its substance.

It has justly been pointed out, as a singular circumstance, that such a treaty should have been concluded at the very time when the British army was abandoning the peninsula, at a time when the Central Junta had fled from the capital—after the Spanish armies were routed and destroyed—after the kingdom was actually conquered, after those even who had been most sanguine in their hopes of the final success of the patriot cause, had given up every thing as lost. The Supreme Central Junta and the British government first abandon Spain to the enemy, and then they pledge themselves, *in the name of the Holy and undivided Trinity*, not to CEDE to him any part of its territory, just as if possession could be rendered less secure by the protest of some forty or fifty individuals. Even had the state of things been much less calamitous than it was, it does not appear that there was any occasion for a treaty of alliance. The common interests of countries are at all times the strongest bond of union. No sooner did the Spanish nation indicate a disposition to resist French invasion, than they applied to Great Britain for assistance, clearly perceiving that the cause of the one was also the cause of the other, and upon the same principle British succours were granted. As long as the Spaniards continued true to themselves, it was evidently our interest to continue true to them, and by refusing to accept the propositions of the enemy for a separate negociation, we gave a proof of our sentiments worth twenty treaties. Admitting, how-

ever, that, in the months of August or September last, it might have been expedient to conclude a treaty of this sort, we cannot conceive by what motive such a step was dictated, at a time when we were withdrawing our armies from Spain, and when there was just as little ground for hoping that we should be able to restore Ferdinand VII. to his throne, as there is now of our being able to wrest, by mere force, the sceptre of France from the hands of Bonaparte. No man who reads the treaty, without excepting even the two individuals by whom it was signed, can seriously believe that it will be fulfilled. Why then contract solemn engagements of this nature merely for the purpose of breaking them, and of declaring to the world that the public faith of nations is far below the ordinary standard of individual honesty?

But supposing that, under the existing circumstances, it was fit and proper to conclude a treaty of friendship and alliance with Spain, are the stipulations of the treaty founded upon the basis of just reciprocity? Far otherwise! Great Britain engages to give up all captures made upon the Spanish trade subsequent to the 4th of July; *foregoes the immense advantages which she might have derived from the liberation and independence of Spanish America!!!* promises to continue to assist, to the utmost of her power, the mother country against France; not to acknowledge any other King of Spain but Ferdinand VII, and not to make peace without the consent of Ferdinand VII. And for all these concessions, engagements and promises (some of which no consideration on earth ought to have induced us to make) what return is to be made by the Spanish government?—Truly, nothing more than this, that the Supreme Junta will not cede conquests already atchieved, or which may be atchieved, and that it will take, not effectual measures, but the most effectual measures, for the preventing the Spanish squadrons in all the ports of Spain, as well as of the French squadron taken in the month of June, and now in the harbour of Cadiz, from falling into the power of France! Why, just as well might the government of this country have engaged not to deliver up the North Sea, or Channel fleet to Bonaparte. But how has this engagement been kept by the Supreme Junta? Our offer to assist in rescuing the Ferrol squadron from the enemy, was indignantly rejected, and 10 or 12 ships of the line were surrendered to him without firing a shot: neither the Cadiz fleet nor the squadron at Carthegena, has to this hour been placed beyond his reach, and the troops sent by this country to insure the safety of Cadiz, have been obstinately refused permission to land! Was any thing ever heard of like this? And

yet, we are gravely told, that another treaty is forthwith to be negociated, stipulating the amount and description of succours to be afforded by his Britannic Majesty; we are to persevere in sending arms and ammunition, money and men to Spain, without knowing how they are to be applied; we are, forsooth, to have the privilege of spending our earnings, and shedding our blood, in the cause of 'beloved Ferdinand,' as long as he, or the government acting in his name, is pleased to permit us; but when we ask to be put in possession of a place to which we can retreat in case of reverse; or, if we ask (surely no very extravagant request) to be allowed to interpose beween the enemy and acquisitions, affecting not only the protection of Spain, but the security of Great Britain, we are to be told, 'No: Give us as much as you please, give us arms, give us subsidies, fight for us, and pay us to fight for ourselves; but Spanish or French ship you shall not touch, and one of our places of strength you shall not enter.'

As to the formidable expedition which is preparing as a diversion in favour of Austria, it is no longer a secret that government did, upon positive information, propose some weeks ago an attack upon the shipping at Antwerp; but their informant was also known to have fled over to the enemy, and was, no doubt, paid on both sides for the discoveries which he made. Antwerp and its shipping were put into a state of more perfect defence, and that object was apparently abandoned. The point now proposed must therefore be a very different one.

But never, surely, was there a moment when annoyance could be expected to be more favourable to our allies than the present, since the necessity of a new conscription by Buonaparte must oblige him to keep up in all his extended empire great internal force, as well as to recruit the losses which he must sustain by a war so wide and wasting. Again and again we must recommend the system of Nelson—*an Army afloat*. There never was a season so applicable to this British plan of warfare—when our ships of war may be fitted for the reception of our troops, in such a way as to make their continuance on board for any length of time perfectly consistent with the preservation of health. By a dextrous use of this plan of attack, the enemy would be so incessantly harrassed as to make it impossible for him to undertake distant

wars—and, in this species of warfare, all our expence would be incurred at home.

In a crisis at once so arduous, though in some respects so unexpectedly favourable, the duties imposed upon our government must be in a corresponding degree important. Ministers either have or ought to have information upon which to form and direct their measures, altogether inaccessible to persons in a private sphere. But the experience of the last campaign, while it evinced the superiority of our troops in action, and strikingly illustrates at least the dauntless intrepidity and glowing valour of our officers, has, we trust, impressed upon every mind the vast importance of a judicious choice of the commander, to whom the honour of the army, and the character and fortunes of the country are committed. When we hear therefore of an intention of sending 40,000 men to the continent, we have the best guarantee of what they can and will do, in what they have done, when their efforts were tolerably well conducted. As to the proposed commander, Lord Chatham, it is not to be supposed that a man can learn the profession of a military commander by intuition; that he can of a sudden divest himself of habits of indolence and inaction, and make up his mind to endure with patience the labours and fatigues of the field. Persons who are capable of thus reasoning, either appreciate ill the magnitude of the task which they undertake, or are grossly ignorant of the constitution of their nature.

In the last volume, we predicted the fate of the campaign in the clearest terms. Now, we are afraid that the Austrian power, if it is not wholly extinguished, will soon be reduced to a condition in which it will have ceased to inspire respect. The crisis is awful beyond example. The danger is every day approaching nearer and nearer to our door, and grievous it is to think that the greater perils our situation presents, the less prepared we are for encountering them. This is certainly not a moment in which we ought to confide our security and existence to a set of ministers in whom there is neither wisdom, nor vigour, nor virtue—to men morally incapable and politically impure—to men whose practical defects would dim the lustre of any talents, and who have not talents enough to cover one defect. No wonder that the people should have lost all confidence in the government when they see it committed to such hands! No wonder that the respect of the people for all public men should have decreased, after beholding a few clerks of office, with qualifications hardly equal to the management of the affairs of a parish vestry, usurp the places of statesmen!

CONCLUSION OF REMARKS ON THE DISGRACEFUL ABUSES IN OUR MILITARY SYSTEM.

The Livery of London, the Westminster and Middlesex Meetings and the Whig Club have all expressed their abhorrence of the late nefarious transactions by numerous resolutions, of which the following are extracts:

That they, from the means of information which their local situation affords them, have long been aware of scandalous and corrupt practices in various departments of the state; and, by the late investigation in the Honourable the House of Commons, the fact has been made manifest to every part of the united kingdom.

That Gwllym Lloyd Wardle, Esq. by his singular intrepidity and integrity, in instituting an inquiry into the conduct of His Royal Highness the Duke of York, and by persevering in that inquiry, in spite of the greatest difficulties and the most formidable discouragements, has rendered an important service to his country, and merits its grateful thanks and warmest approbation.

That it is their unanimous opinion, that after the concurring declaration of so many independent representatives of the people, whoever shall at any future time advise his Majesty to reinstate his Royal Highness the Duke of York in the situation of commander in chief, will, by such advice, prove himself an enemy to the country.

That these abuses form only a part of a wicked and corrupt system, which has been long acted upon, and no permanent good can arise from the late investigation, unless followed up by a general reformation of public abuses in every department of the state.

That their burthens have been considerably augmented by gross abuses in the management and expenditure of the public money, and by a profusion of sinecure places and pensions, which have not only added to the sufferings of the people, but created a pernicious influence, corrupting and undermining the free principles of the British constitution.

That no measures calculated to remove these oppressive and alarming evils have yet been adopted, nor can any rational expectation be formed that such measures will be adopted, while the management of the public affairs is in the hands

of persons who are themselves the greatest pensioners and reversionists in the kingdom.

That it has appeared, by the report of a committee of the House of Commons, that 78 members of that House, are in the receipt of 178,994l. per annum out of the public money, who, with their relations, and the naval and military officers in that house, must give a most preponderating and dangerous influence to the ministers of the crown.

That if any doubt could remain as to the baneful effect of such influence, it has been sufficiently exemplified by the rejection of Mr Wardle's late proposition in Parliament, against the most conclusive evidence, and unequivocal sense of the country; where it appeared that all his Majesty's ministers—all the placemen—and all the pensioners, then present (stated to be 82 in number) voted against the said proposition; while, of course, in the minority of 125, not one of the ministers—not one placeman—not one pensioner—and only one naval and one military commander was to be found.

That the conduct of the ministers in the House during the late inquiry, has been a complete dereliction of that duty which as representatives of the people they owe to their constituents, and has proved them to be wholly unworthy of the confidence of the country.

That other governments have crumbled into ruin—other states have been subverted, and their ancient and venerable institutions overthrown, by the folly, profligacy, and vices of their rulers; and that unless this overwhelming tide of corruption be resisted by temperate and timely reformation, it must inevitably lead to the ruin and subjugation of this country.

That it is their decided opinion, that no substantial and permanent good can be derived by the country from any change of ministers, unless accompanied by an entire change of system—a reform of all existing abuses in every department of the state, and an abolition of all unnecessary places and pensions, which recent events have clearly proved can only be effectually accomplished by a reform of the representation of the people in parliament.

That it is their opinion, that the discoveries made by this inquiry, as well as the attention which has been paid in the House of Commons to the investigation of the charges brought in this particular instance, ought to animate the people to prosecute inquiry and reform in all the departments of the state, and they recommend to every county, city and borough of the united kingdom, in which the present state of the elec-

tive franchise will admit it, to return, free of expence, honest and independent representatives, who shall have no interest but that of restoring what is obviously wanted—integrity and economy in the receipt and expenditure of the public money, and preserve inviolate the rights and privileges of the people."

The resolutions which were put, and unanimously carried on these occasions, evince the existence of a spirit in this country, which only needs to be called forth and properly directed in order to set all its enemies at defiance. We are convinced that the result of such meetings will be more eminently and durably beneficial than that of any victory that our fleets or armies ever gained. It is, in fact, to the principles which have dictated these resolutions that we owe all our greatness and prosperity as a nation.

Still, however, the Duke of York has been succeeded by General Sir D. Dundas, an officer only known to the country by his signature to a public document, which absolved of all fault an act which has entailed an everlasting disgrace upon the British character. When we see such a man appointed as successor to his Royal Highness, we must feel that little can be done where such a proxy remains.

ABUSES IN EAST INDIA AFFAIRS.

The committee appointed to inquire into these abuses, has made discoveries of the most important kind; and though it has, in a summary way, acquitted the Directors of all direct participation in the profits of the sale of writerships and cadet appointments, yet the circumstantial evidence of privity is so strong, that the proprietors of India stock must be lost to all sense of decorum, if they do not act upon the information they have received.

The measure proposed, of vacating the appointment of every man for whom such appointments were obtained by corruption, is dreadfully severe; and, if adopted in this instance, we presume, must be equally applied to all the departments of the state; for it is justly suspected, that, in every one of them, places are clandestinely made the subject of traffic. If all grants are to be rescinded which have been corruptly bestowed, it is a reform such as its warmest friends did not expect to see, and which must strike terror into the hearts of many lofty and distinguished men. All this is to be ascribed to Mr Wardle's motion; for it was by the disclosures fortunately made during the examinations at the bar, that the lucrative trade of broker-

age in places, commissions and appointments, was developed, and that gave rise to the committee on East India patronage. Is not, however, this suggestion calculated, though not intended, to turn the hearts of men against reform?

Instead of dismissing the Director who, either from negligence or something worse, has improperly dispensed the patronage of his office, the remedy proposed is to deprive the young men, for whom appointments were bought, of their situations! We really cannot conceive a greater act of cruelty and injustice than this. It is inflicting the punishment due to guilt upon innocence; it is exposing, not the impostor, but the dupe; it is attacking, not the culprit, but the victim! It savours of nothing short of barbarity, to dismiss twenty or thirty young men from situations for which they have been educated, upon which they have entered, and which some of them have held for years, because they were purchased for them, perhaps without their knowledge, by a parent or friend.

It now clearly appears that Lord Castlereagh has acted a principal part in these abuses. The transaction referred to was one, the object of which was, to procure a seat in parliament for Lord Clancarty, in lieu of a writership, placed at his disposal by Lord Castlereagh!! The fact is admitted.

PARLIAMENTARY REFORM.

The investigation into the conduct of the late commander in chief involved no question of profound or intricate policy, the decision of which required various information or very enlarged views, to which only persons of deep research and refined education can attain. It was a simple question of guilt or innocence, upon evidence of which every man qualified to sit upon a common jury was just as competent to judge as any lawyer or statesman in the House of Commons. It consequently was so conducted that the evidence was published and read by every man throughout the country. But we have never heard it alleged, either in the House or out of it, that this decision of the House of Commons corresponded with the general, we may almost say the universal, expectation of the country. The corruptions indeed which that investigation unfolded to the public view, and the conduct of ministers during it, manifested the absolute necessity of reform far beyond the numerous volumes which had been written by most judicious men in its recommendation.

The recent decisions upon the charges preferred against two of his Majesty's ministers lead still more irresistibly to the same conclusion. It had been frequently and strongly urged in debate that the advocates for reform dealt only in vague insinuations and general abuse, which it was impossible either to combat or repel. Bring forward, said the other party, your charges in a tangible shape, and we will both meet and refute them. Accordingly, a charge was brought against Lord Castlereagh, founded upon a report of a committee of the House, charging him with an attempt to obtain, by means of the patronage of his office, a seat in the House for his friend and colleague Lord Clancarty. The fact was admitted, the author of this attempt against the privileges of Parliament was permitted to pass without censure, and the culprit yet retains both his seat and his office. He *meant no harm*, and *if he did*, his intentions were *not carried into effect*, and this pitiful avowal is all the satisfaction which the public has received or is likely to obtain for the gross malversation of a person acting in the double capacity of a servant of the crown and a representative of the people!

Soon after a double charge was again brought, certainly in a tangible shape, against this Noble Lord and the Chancellor of the Exchequer, accusing them of having sold a seat in the House of Commons to a gentleman, on condition that he should give them his Parliamentary support, and of having afterwards insisted that he should resign this seat, because on a certain question he could not conscientiously vote for them—And what happened on this occasion? The parties accused declined either to confess or deny the truth of the charge, and the House of Commons refused to entertain it.—Yes; after spending six weeks in investigating charges brought against the Duke of York—after scrutinizing with minute and painful severity all the transactions of his public and private life for six or seven years back, yet when a charge was brought against Mr Percival and Lord Castlereagh, the House refused to entertain it, because, forsooth, the information upon which it was grounded, was procured by a breach of private confidence, (though we hear every day of pardons being offered to culprits who turn king's evidence, or of felons being convicted upon the testimony of associates!) and because the act of delinquency, however odious in its character, and however dangerous in its tendency, had been so frequently practised, that it would be the height of injustice to punish it, even though in an individual instance it could be detected. And yet the persons who hold this language, talk of the spotless purity of

the government, the immaculate virtue of public men, and the total want of necessity for any thing like reform!

Nothing can be more disingenuous than the whole conduct of ministers, as connected with the question of reform, whether as tending to the correction of practical abuses, or the improvement of the representative system. When accused and *convicted* of conniving at corruption, they have screened themselves from punishment, by setting up a plea of its being the general practice of all men in office, and at the same time artfully professed the utmost willingness to entertain and support any measure by which the recurrence of such practices should be prevented in future.—They, however, proposed no remedy themselves, and when a worthy and independent member of parliament took up the subject, under pretence of canvassing the bill, which he brought in, they contrived to string together a set of legislative provisions, the obvious tendency of which is to secure to the treasury a complete monopoly of borough patronage, and thereby greatly to increase the influence of the crown in the House of Commons.

The same observation is applicable to their conduct as connected with the measures recommended by the committees of finance and of military inquiry. If any person, either in or out of Parliament, venture to suggest that a reform in the national representation would be productive of economical, or other political benefits, they are immediately put down by a reference to the labours of these committees, which ministers alledge tend to the same object, without incurring any of those risks which may arise out of untried speculations. But do they act upon the recommendation of these committees? Did they not object to the reversion bill at the beginning of the session? Have they reduced the pension list? Have they abolished a single sinecure? And did they not only the other day, when they were applying to Parliament for an increase to the salaries of the judges, refuse to act upon the recorded opinion of the committee of finance, that the sales of offices in the courts of law ought to be prohibited?

Notwithstanding these glaring inconsistencies and tergiversations, parliament and the country have been day after day insulted by hypocritical professions of candour, of a readiness to discuss, a desire to conciliate—in short, with all the mummery of political methodism. While Mr Percival acknowledged what all the world knew, that he was an enemy to parliamentary reform, he expressed a wish that the question should be fairly and deliberately considered, trusting, no doubt, that his persuasive powers would convince the reason-

able, and silence the clamorous part of the community. But when notice was given of a motion, on which the opinion of the House must be pronounced, either *pro* or *contra*, and when the day fixed for the discussion arrives, not a man appears upon the Treasury Bench—there is not a sufficient number of members present to make a House, and arrangements are taken for the purpose, if possible, of preventing the subject from being brought forward in the present session. We trust, however, that the people are too sharp-sighted to be deceived by such miserable expedients, and that while they persist in endeavouring to obtain a constitutional object by constitutional means, they will not forget the juggle which is thus attempted to be practised upon them, by an administration which has neither the boldness openly to resist their pretensions, nor the wisdom to accede to their just demands.

But the system of abuse had existed with increasing strength for the last fifty years. Various remedies have been proposed to counteract and to prevent its progress. Has not the experience of past times proved to the country that such exertions were ineffectual? Has it not seen report after report, inquiry after inquiry—the most barefaced speculations brought home to public official malversators—the most flagitious acts of oppression to public delinquents; and what has been the result? Has punishment followed the conviction of their crimes? Unhappily for the interests of Britain, no such consequence has ensued. The people have seen official guilt uniformly protected in every rank of society, from the elevated station of his royal highness the late commander in chief down to the gaoler of Cold Bath Fields prison. To what are such lamentable effects attributable? Certainly to the want of an honest and independent House of Commons, a House anxious to defend the nation's liberties, and determined to reflect punishment upon all who transgress against our freedom and our confidence.

The inconsistency, moreover, of even legislating about petty sales of places, while the traffic of seats in the House, so infinitely more mischievous, is allowed to remain undisturbed must be very evident.

Much has been said upon the motives of those who now come forward to agitate the question of reform, and truly very little indulgence has been shewn them. It is, however, easy to make it appear, that the discussion has not originated either in a conspiracy to degrade public characters, or in a deep laid plot against the constitution of the country (the two causes to

which it has been principally imputed), but to the prevalent want of sympathy between the constituent and the representative bodies. Mr Whitbread is a strenuous supporter of reform. Lord Grey declares himself a friend to a temperate, intelligible and definite reform. Even the Speaker of the House of Commons seems deeply impressed with its necessity. It is opposed by none but those whose temporary prosperity depends upon the subversion and subjugation of the empire.

If, however, there be any persons who teach the people to expect from reform relief from taxation, or any very great alleviation of the public burthens, such persons are either ignorant or designing. What it would give them is a more effective voice in the application of the money which they pay, and security against its being improvidently squandered, or employed on any other objects than those connected with the safety, prosperity and glory of the commonwealth.

There are doubtless many individuals of distinguished talents and tried integrity, who, as ministers, at this moment merit the confidence of the country; but, till some remedy be applied to the faults of the present system, even their genius and virtue, were they called into action, would be obscured by that cloud of pestilential vapour, which, until it is dispelled, will envelope every administration, however unobjectionably composed.

The best members of the last administration felt the truth of this observation in the short time that they were in office. Wherever they looked they saw abuses to which they anxiously wished to apply remedies; but, strong as they were from integrity, from very considerable talent, from rank and property, they found that, without the aid of the people, they were utterly incompetent to overthrow the influence behind which these abuses lay entrenched. They gave the court and all the abettors of corruption mortal offence, by attempting what they did; they disappointed the people by not attempting more; the consequence was, that when a convenient opportunity occurred, they fell the victims of the resentment which they had provoked, and from which there was no effort made on the part of the public to shield them. Had they begun by reforming the Parliament, they would have found the subordinate reforms which they meditated in the different departments of government infinitely more easy of execution, and, by fulfilling the expectations of the people, they would have secured to themselves protection from the host of jobbers and intriguers against whom they had declared open hostility.

And, supposing that, without this auxiliary, a ministry were strong enough in themselves to accomplish the object of introducing a number of beneficial practical reforms into the different departments of government, what security would the people have, while the source of these abuses remains, that the current, after being checked for a time, would not, under some future and less virtuous administration, burst forth with fresh violence? All remedies are insecure which, instead of being directed to the cause, are addressed solely to the symptoms of diseases. It is vain to check the growth of one abuse while you leave the seeds of a thousand others to spring, to vegetate, and to mature.

We wish not to invade the privileges either of the crown or the aristocracy; on the contrary, there is nothing which we deprecate more than placing the government in such circumstances as to render it liable to be swayed in its decisions, or influenced in its conduct by popular clamour. We do not wish either for universal suffrage or annual parliaments, because we think that property, whether in land, or money, or talents, ought to be the basis of all representation; and because we are convinced, that were the property of the country fairly and fully represented, it would not be necessary every year to renew the appeal to the constituent body, although a more frequent recurrence to the people, than the present septennial one, we think indispensible. Far less do we wish to see the responsible ministers of the crown excluded from the House of Commons; because when men are accountable for their measures, they ought to be allowed an opportunity of defending them;—because we would not be guilty of the illiberality of desiring to see the members of government, in every instance where their conduct appeared to be faulty or questionable, summoned like criminals to the bar upon their defence;—because their presence in the House furnishes members with the facility of obtaining from them information upon the state of public affairs;—and, lastly, because, were they themselves excluded, they might easily recur to the expedient which has been adopted in America, of employing agents to convey their sentiments, and exercise their influence over the House.

But we do not wish to see a minister commanding by dint of authority or influence a decided majority in the House of Commons, upon any measure which he may think proper to propose, whether for the good or the detriment of the realm. We do not wish to see such a glaring and monstrous contradiction between the theory and practice of the constitution, as a law to prohibit peers from interfering in elections, while at

every election they are permitted to nominate members of the House of Commons, or to sell seats in that assembly to whoever is disposed to purchase them. We do most sincerely desire to see an end put to that most infamous traffic which is now avowedly carried on at the Treasury *under every administration*, in the purchase and sale of boroughs, by which the taxes paid by the people are first employed to pollute the fountain of representation, and the fruits of corruption are afterwards converted into instruments of still farther increasing the public burthens. We desire to see an end put to the jesuitical distinction at present existing between bribery before, and bribery which is daily practised, under the title of benevolence, after an election. We devoutly wish never again to have imposed upon us the truly mortifying task of recording the resolutions of the most respectable counties and cities of the kingdom, declaring the decision of the House of Commons, upon a most important question, to have been at variance with the most unanimous sense of the nation.—We respect the monarchical and aristocratical branches of the constitution just as much as the democratical branch of it; our only object is to restore and maintain the balance which ought to subsist among the three parts of which the constitution is composed, and which we contend never can be effected while the people are not fully and fairly represented.

There are some individuals who profess to be friendly to Parliamentary Reform, and who are of opinion, at the same time, that it ought to be postponed to a period of less embarrassment and greater tranquillity. But we own that to us this argument has very little weight. When abuses are known to exist, no time can be improper for correcting them, nay, the greater the danger to which we are exposed, the more important it is to remove every obstacle to cordial, unanimous and vigorous exertion. Does any one believe that the government can be long supported, or the country successfully defended, by corruption? Is it not in the nature of this vice equally to degrade its agents and those upon whom it is practised? Is not dependence the bane of freedom, and venality the poison of every generous and manly sentiment? To what but to our liberties, and the attachment which the people entertain for them, can we rationally look for those efforts which can alone secure us against the overwhelming power, and all devouring ambition, of the enemy? One corrupt member of the House of Commons is to the people of these islands a far more dangerous foe than all the marshals of France. The country in which we live can never be conquered but through its Parliament.

CONCLUDING OBSERVATION.

The preceding sentiments are collected as faithfully as possible from the general sense and general language of the country. But they are, at the same time, the sentiments which for many years I have felt, and which I feel a pleasure in repeating. It is even several years since I publicly stated that the abandonment of purchase and of interest in all public stations, and the unequivocal reward of merit, was, in the present crisis of European affairs, essential to the salvation of the empire.*

* See "Political and Military State of Europe," Second Edit.

PATENT OFFICE LIBRARY.

ARCHIVES

OF

UNIVERSAL SCIENCE.

PART II. ARTS.

MATHEMATICAL ARTS.

NEW METHOD OF DIVIDING MATHEMATICAL INSTRUMENTS.

BY MR CAVENDISH.

Mr Cavendish lately laid a paper before the Royal Society on the methods of dividing mathematical instruments, in which he proposed to substitute a balance compass and microscope for Mr Troughton's cylindrical ruler. The plan was illustrated by a drawing of the instrument, which effected the purpose without the necessity or risk of calculations, which almost always involve errors.

ON THE FIBRES USED IN MICROMETERS.

BY DR BREWSTER.

Scientific men have often had occasion to regret the difficulty of procuring fibres sufficiently fine and elastic for micrometers. The difficulty of obtaining silver wire of a diameter small enough, induced Mr Troughton to use the spider's web, which he has found so fine, opaque, and elastic, as to answer all the purposes of practical astronomy. But as it is only the stretcher, or long line, which supports the web that possesses these valuable properties, the difficulty of procuring it has compelled many opticians and practical astronomers to employ the raw fibres of unwrought silk, or what is still worse, the coarse silver wire manufactured in this country. For these, Dr. Brewster has succeeded in obtaining a substitute, in a delicate fibre which enables the observer to remove the error of inflection, while it possesses the requisite properties of opacity and elasticity. This fibre is made of glass, which is so exceedingly elastic that it may be drawn to any degree of fineness, and can always be procured and prepared with facility. This vitreous fibre, when drawn from a hollow tube, will also be of a tubular structure, and its interior diameter may always be regulated by that of the original tube. When such a fibre is formed and stretched across the diaphragm of the eye piece of a telescope, it will appear perfectly opaque, with a delicate line of light extending along its axis. As this central transparency arises from the transmission of the incident light through the axis of the hollow tube, and as this tube can be made of any calibre, the diameter of the luminous streak can be either increased or diminished. In a micrometer fitted up in this way by Dr. Brewster, the glass fibres are about $\frac{1}{1200}$ of an inch. in diameter; and the fringe of light is distinctly visible, though it does not exceed $\frac{1}{3000}$ of an inch. In using these fibres for measuring the angle subtended by two luminous points, the fibres may be separated, as hitherto done, till the luminous points are in contact with the interior surfaces; but, in order to avoid the error arising from inflection, it is proposed to separate the fibres, till the rays of light issuing from the luminous points dart through the transparent axes of the fibres. The rays thus transmitted evidently suffer no inflection, in passing

through the fibre to the eye; and, besides this advantage, the observer has the benefit of a delicate line, about one-third of the diameter of the fibre itself.

NEW GONIOMETRICAL TELESCOPE AND MICROSCOPE.

BY DR BREWSTER.

Dr Brewster of Edinburgh has also invented a new goniometrical telescope and microscope, for measuring the angles of crystals by reflection, and for ascertaining the inclination of strata, and the apparent magnitude of angles when the eye is not placed at their vertex.

The same gentlemen has also invented an insrument for determining distances at one station, without measuring a base, without a portable base being attached to the instrument, or without knowing the magnitude of the object the distance of which is to be ascertained. A long base is actually created by the instrument, without measuring it; and the distance is obtained upon a principle, which, as far as we know, has never been employed in trigonometrical instruments.

ON BAROMETRICAL MEASUREMENTS.*

M. De la Place in his *Méchanique Céleste*, M. Ramond in the *Mémoires de l'Institut*, vol. vi., and M. Daubisson in the *Journal des Mines*, February 1807, have recently brought to perfetion, the method of measuring altitudes by means of the barometer. Their memoirs are highly deserving of being translated into English: it is at least certain, however, that it would be agreeable to the geologists of this country, and to those of foreign nations who make use of instuments graduated in the English way, if the second of the two methods of M. Ramond was reduced into the measurements of this country. This second method has the advantages over the first of being the most expeditious, and at the same time almost imperceptibly exact. I have undertaken this task, and shall be happy

* From Nicholson's Chemical Journal.

to see it inserted in your Journal, if you find it worthy of publication.

The principal part of this work consisted in the reduction of the table of M. Ramond; the object of which is, to have a view in calculation, to the gravity at different parallels of latitude at which we take observations. His second method abridges considerably his first; and, in my opinion, all antecedent methods where exactitude was the object in view. I subjoin this table calculated upon the co-efficient 10057·6 fathoms, which corresponds to 18393 metres, being that of M. Ramond.

You will perceive that the result of the calculation, according to my reduction, gives the altitudes in fathoms in place of giving them in feet as in England. In this trifling change, I find two advantages: In the first place it renders the calculation a little shorter; and secondly, it presents the altitudes in numbers more easily fixed in the imagination than more complicated numbers. In short, we cannot form a very distinct idea of the height of a mountain, when we state it as 19,000 feet, whereas three miles and some fathoms will impress the real height much more strongly on the mind.

The examples subjoined show the method; and I presume will require no further illustration to those who are acquainted with logarithms. I shall only observe, that in reducing the metre to fathoms, I have made use of the report whch I found in the Memoirs of the Royal Institution, Vol. I., namely, $1^{m}39{\cdot}371$ English inches: and with respect to the thermometer, I have made use of the well known report 100 : 180, those two numbers marking the space of the scale comprehended between the freezing and boiling points: thus in calculation the degrees of Fahrenheit should be diminished 32° for the degrees above the freezing point, and on the contrary with respect to the degrees below melting ice, they must be retrenched from 32°.

In the first of the following examples, I have applied to the least height of the barometer, the difference of the thermometers which are attached to them, because the thermometer was lower than in the other.

In the second example it is the contrary, because the thermometer attached was highest at the station where the barometer was lowest. The rule is to augment the height of the column of mercury, in the coldest station, by so much as $\frac{1}{97416}$ as there are degrees of difference between the thermometers of correction. The perusal of M. Ramond's Memoir will greatly assist the reader on this subject.

Example I.

	Barometer.	*Fahrenheit's Thermom. fixed.*	*Fahrenheit's Thermom. free.*
At Tarbes *	28·961 English inches	65°·51 — 32° = 33°·51.	(66·41) — 32° = 34°·41.
Pic du Midi	21·150 - - -	(49 ·55 — 32 = 17 ·55.	(39·20) — 32 = 7 ·20.
Latitude	43°.	Difference 15 ·96	41 ·61.
			Two sums 83 ·22.

28·961 - - - - - - -	Log. 1·4698069.
21·150 - - - -	Log. 1·3253148.
9741·6 Constant + diff. 15·9	
= 9767·6 - - -	Log. 3.9893430.
9741·6 Constant - -	Log. 6·0113697.
	1·3260275. 1·3260275.
Difference between the logarithms of the altitudes	0·1437794 Log. 9·1328338.

Take in the subjoined Table for 43° of latitude, the logarithm 4·0025805.

$$\frac{1800 \text{ Constant} + \text{two sums } 83{\cdot}22}{1800} = \frac{1883{\cdot}2}{1800} = 1{\cdot}0462 \text{ Log. } 0{\cdot}0196147.$$

Difference of the heights in fathoms 1429. 3·1550290.

* Tarbes is a town in the Pyrenees, (province of Bigorre,) which lies at the foot of the mountain called *Pic du Midi*.

Example II.

	Barometer.	*Fahrenheit's Thermom. fixed.*	*Fahrenheit's Thermom. free.*
Summit of mount Saleve *	28·3951	(72·1) — 32 = 40°1	(73·9) — 32 = 41·9
Foot of ditto - -	25·7120	(78·) — 32 = 46·	(65·) — 32 = 33·
			74·9
Latitude	46·°10′	Difference 5·9	Two sums 149·8

25·712 - - - - - - - - Log. 1·4101359

28·3951 - - - Log. 1·4532434

9741·6 + 5·9 = 9747·5 Log. 3·9888932

Constant - - Log. 6·0113697

1·4535063 1·4535063

0·0433704 Log. 8·6371934

By the Table for 46° of latitude nearly - - - 4·0024513

$\frac{1800 + 149{\cdot}8}{1800} = \frac{1949{\cdot}8}{1800} = 1{\cdot}0833$ - - - - - - Log. 0·0347487

Difference of the altitudes, fathoms 472·49 2·6743934

* Mount Saleve is in Switzerland.

Table of the Logarithms of the Coefficients calculated for different Latitudes—Supposing the coefficient equal to 10057·6 fathoms for the 45 degrees.

Latitude.	Logarithms.	Latitude.	Logarithms.
1	4·0037276	37°	4·0028344
2	7254	38	7930
3	7215	39	7510
4	7164	40	7087
5	7097	41	6662
6	7014	42	6234
7	6917	43	5805
8	6816	44	5375
9	6683	45	4944
10	6540	46	4513
11	6385	47	4083
12	6217	48	3654
13	6035	49	3226
14	5839	50	2801
15	5630	51	2378
16	5609	52	1958
17	5174	53	1544
18	4927	54	1131
19	4668	55	0723
20	4397	56	0321
21	4114	57	4·0019924
22	3820	58	9534
23	3516	59	9194
24	3201	60	8774
25	2876	61	8404
26	2541	62	7048
27	2197	63	7691
28	1845	64	7347
29	1484	65	7012
30	1114	66	6687
31	0737	67	6372
32	0354	68	6068
33	4·0029964	69	5774
34	9567	70	5491
35	9165	71	5220
36	8757	90	2604

DESCRIPTION OF A GAUGE OR MEASURE FOR STANDING TIMBER.*

BY MR JAMES BROAD.

THE Instrument I send herewith is for finding the girth of standing timber, and will, I flatter myself, be found exceedingly useful to all gentlemen, and others having timber to dispose of, and likewise to such purchasers as wish to pay for the true quantity. At present, a gentleman having timber to dispose of is liable to be imposed on to a very large amount; for though some surveyors may be found whose eye is pretty accurate, yet this is far from being generally the case. When an estate is sold on which the timber is to be valued, I believe, there is no other way in general use of finding the girth of a tree (which being squared and multiplied by its length, gives the contents) than by actually getting up to the middle, where the girth is usually taken, with a ladder or otherwise: a method which is very troublesome and expensive where the quantity is large. The seller has, therefore, no way, but at an enormous expense, of finding the real contents of what he has to offer, and as the buyer, if a dealer, from his knowledge is able to form a more accurate judgement, it often happens, that the seller sustains much loss. *I have known it exceed* 50 *per cent.* Having some time ago a large quantity to survey, I thought it possible to invent an instrument, which would obviate this inconvenience, and which might be sold at a low price, be correct in its work, quick in execution, and such as any capacity might use. I likewise thought it might be so contrived, as to make such an allowance for bark, as should be agreed on. The instrument I send you possesses all these qualifications, and is susceptible of several improvements, of which I was not aware when I made it, which I will point out at the end of my letter.

It is well known, that the diameter and circumference of circles are in a certain proportion to each other, and that double the diameter gives double the circumference. The allowance for bark is usually one inch in thirteen, that is, if the greater cir-

* Trans. of Soc. of Arts, Vol. XXV, p. 18.

cumference of a tree, with the bark on, is found to be thirteen inches, it is supposed it would be only twelve inches if the bark was taken off.

The instrument is composed of two straight pieces of well seasoned deal, about thirteen feet long, joined together by a pin going through them, on which they are moveable; but neither the length nor thickness is of any particular consequence, as, by following the directions hereafter given, they may be made of any size. A little way from the larger end is a brass limb, I call the index, on which are engraven figures denoting the quarter-girth in feet and inches. To use this instrument, it is only necessary to take hold of the large end, and apply the other to that part of the tree where you wish to know the girth, opening it so wide as just to touch at the same time both sides of it, without straining it, keeping the graduated side of the index uppermost, on which the girth will be shown, after allowing for the bark, by the inner edge of the brass on the right hand leg. An operation so easy and simple, that a person of the meanest capacity might measure a great number of trees in a day.

For taking the height of a tree, I would recommend deal rods of seven feet long, made so as to fit into ferrils at the end of each other, tapering all the way in the same manner as a fishing rod. A set of five of them, with feet marked on them, would enable a man quickly to measure a tree of more than forty feet high, as he would be able to reach himself about seven feet.

The improvements it is capable of are, making a joint in the arch or scale, to enable it to shut up (when the legs are closed) towards the centre, which would make it easier to carry. Secondly, as it sometimes happens, that standing timber is sold without any allowance for bark, and at other times with a less allowance than one inch in thirteen, two other scales on the index might be added in such cases, one without any allowance, and the other to allow as might be agreed on. I would have added these, but thought the Society would rather see it in the state in which it has been tried on a large survey, as any artist can with great ease add whatever scale he pleases. The present scale allows one inch in thirteen for bark, and is calculated on the following data. The diameter of a circle the quarter circumference of which is 26 inches, is 33 $\frac{90}{100}$ inches. The diameter of a circle, the quarter girth of which is 6½ inches, is 8 $\frac{27}{100}$ inches. To graduate the scale, the instrument is opened so as to take in at the small end between the touching points 8 $\frac{27}{100}$ inches, and a mark is made on the arch to

denote 6 inches quarter girth: it is then opened so as to take in 33 $\frac{96}{100}$ inches, and another mark is then made on the arch, to denote two feet quarter girth; (these marks are made close to the inner edge of the brass on the right hand limb): the space between them is then divided into eighteen parts, which represent inches, and these are again divided into halves, for half inches; if any notice is to be taken of quarter inches, the eye will easily make a farther decision.

I beg leave to add, that it is not my intention to make any for sale.

Reference to the Engraving of Mr James Broad's Machine for measuring standing Timber. Plate I. Fig. 1.

Fig. 1. *a a a a* Two long pieces of well seasoned wood, joined near the middle by a pin *b* going through them, forming an axis on which they move. *c c* Two pieces of brass screwed near their upper ends, on the sides opposite to each other, and projecting over to form the measuring points. *d* The index fastened to one of the pieces of wood at *e*, and moving freely under a small bar at *f*. *g g* Screws with nuts, placed in the middle of the long slits of the two arms, to wedge them open, whereby the vibration is destroyed, and the arms, though light, are rendered stiff. *h h h h* Screws and nuts to prevent the arms from splitting.

A certificate from Mr J. Wilkins, carpenter, of Sandy-Lane, dated May 4th 1805, stated, that he had used the instrument invented by Mr J. Broad, for measuring timber standing, and that he believes it to be a correct and valuable one.

MECHANICAL ARTS.

DESCRIPTION OF AN IMPROVEMENT IN JURY MASTS.

BY CAPT. WILLIAM BOLTON, OF THE ROYAL NAVY *.

HEREWITH you will receive the model of a plan for fitting ships' jury masts, to be formed from the spare spars usually

* From *Transactions of the Society for the Encouragement of Arts, Manufactures, and Commerce*, for 1808.——The silver medal of the Society was voted to Capt. William Bolton for this communication.

carried on board king's ships, and in every merchantman that is properly found. By having jury masts so fitted, ships will be enabled to carry as much sail as on the usual regular mast; the great use of which I need not dwell on, only observing that it may be of great importance to fleets after a general action, or when in want of proper lower masts, either at home or abroad, and enable ships, after the loss of their mast, to prosecute their voyage, or service, without any deficiency of sail.

I beg you will be pleased to lay it before the Society.

REMARKS.

In the model in the Society's possession the main mast is broken about one third of its length above the deck, proper partners are secured on the deck, in which a hand mast and spare main top mast are fixed on each side of the broken main mast, and secured thereto by two spare caps, morticed on a square made in its centre. A strengthening cap, moveable on these additional masts, connects them, and the upper parts of these masts are secured firmly by trustle trees in the main top. The foot of a spare fore top mast passes through a cap made from strong plank, morticed into the heads of the two temporary masts above mentioned, goes through the main top, and rests in the moveable strengthening cap, which connects those two masts, and enables the fore top mast to be raised to any height which the main top will admit, and be then firmly secured by the upper cap, the main top, and the strengthening cap below it. The fore top mast being thus adjusted, the cross trees and top gallant mast are mounted upon it, which completes the whole business.

Two caps are the only things necessary to be made expressly for the purpose, the other articles being usually ready on board the ship.

Reference to the Drawing of Capt. Bolton's Jury Mast. Plate 1. Figs. 2, 3, 4.

In figs. 2, 3, and 4, A A represents the partners or pieces of timber which are bolted to the quarter deck for the mast to rest upon. B is the stump of the lower mast, which is cut square at the top, and of the same size as the head of the mast originally was; upon this square, the main and spare

lower caps *a a* are fixed; two mortices must be cut in the partners A A to receive squares made at the lower ends of the two temporary masts D D, which are supported by the caps *a a*; one of them is a spare main top mast, the other a hand mast; these two support the main top E, additional squares being made on the trustle trees to receive each of them. *b* Is a cap shown in fig. 3, made of four-inch plank doubled for the purpose, and fitted upon the heads of the masts D D, for a top mast F F, the heel of which rests in a mortice made in the stump of the lower mast; it is also steadied by a double cap G, separately shown in fig. 4, on which it fits finally on the top. The top-gallant mast H is fixed to the mast F by the top and cap in the usual manner. The figures 3 and 4, show the caps separated from the masts, and are the only things necessary to be made for the purpose; and the object of the cap, fig. 3, is to steady and prevent any wringing of the lower jury mast, and to fid the top mast whenever it is reefed. The fore top mast F F appears in two separate pieces, on account of its length.

IMPROVEMENT IN ANCHORS, TO RENDER THEM MORE DURABLE AND SAFE FOR SHIPS; AND AN IMPROVED MODE OF FISHING ANCHORS.

BY CAPT. H. L. BALL, OF THE ROYAL NAVY *.

THE great expence of timber in the navy for anchor stocks, and the frequency of their failing or giving way in the centre, where the square of the anchor is let into the stock, have induced me to offer to the Society of Arts, &c. a plan of an anchor which may be cheaper in construction, and more likely to hold in various situations than those in common use.

The model I have sent will sufficiently explain my intention, and show how beneficial it may be in strengthening the anchor stocks. I wish much to notice to you its probability of holding in the ground longer than other anchors, on account of the additional weight of the stock; and this will more particu-

* From *Transactions of the Society for the Encouragement of Arts, Manufactures, and Commerce*, for 1808.——The silver medal of the Society was voted to Capt. H. L. Ball for this communication.

larly be the case in banks which shelve suddenly down from the shore, such as at St. Helena, Cawsand Bay, and indeed in most of the islands in the West Indies. The proportion of additional iron, as explained by my model, is in all anchors to be twice and a half the diameter of the shank from each side at the stock, and of course this mode will supply the place of the present nuts, which are only intended to prevent the stock from slipping in and out, whenever it becomes loose; which accident, anchors are very liable to in hot climates. My anchor stocks will save a considerable quantity of the finest timber, and give much greater security.

I likewise beg leave to offer to the Society a model of a double fish hook, for the purpose of fishing the anchor, an operation which, in the common mode of doing it, is frequently attended with accidents both to the ship and crew, from the anchor suddenly slipping unexpectedly in raising it to its proper position.

I flatter myself that these improvements will meet with the Society's approbation.

Reference to the Engravings of Capt. H. L. Ball's method of Fishing an Anchor. *See* Plate 1. Figs. 5 and 6.

Fig. 5, Pl. 1, represents Captain Ball's method of fishing an anchor. Fig. 6, shows an enlarged view of his double hooks used for that purpose.

In the usual operation of heaving an anchor, it is drawn up by the cable until it appears above water; the cable will not now raise it higher, it is therefore bowsed up by the cat block *a*, fig. 5, from the cat head *b*, the cable *d* being slackened out as it rises. When it is got up as high as the cat block will raise it, a strong hook, called the fish hook, fastened to a rope *e*, which is suspended by a tackle from the shrouds, is hooked to the anchor at the bottom of the shank, and thus the arms of the anchor are elevated above the stock, until one of the flukes is brought up to the timber heads *f f*, to which it is made fast by a rope and chain, called the shank painter. In this operation, the fish hook sometimes slips, and occasions mischief; to remedy which, Captain Ball has applied two hooks instead of one, which keep firmer hold. These hooks are shown upon an enlarged scale at *g g*, fig. 6, attached to the rope *c*; each of these hooks takes one of the arms of the anchor, close to the shank, and holds it firmly. *i i* Are two

small lines made fast to the hooks, to direct them so as to get proper hold of the anchor.

Reference to the Engraving of Captain H. L. Ball's Improvement in the Formation of Anchors. *See* Plate I. Figs. 7, 8 and 9.

This anchor, in external appearance, differs very little from the common anchor; the improvement consists in forming and fixing of the shank of the anchor to the stock. The stock *a a*, fig. 7 and 8, is made of two pieces of oak bolted together, and well secured by hoops. In the common method, in order to prevent the anchor stock from slipping off the shank, a square projection *b b*, fig. 9, is forged upon the shank; this is improved by Captain Ball, as shown in fig. 7, where this projection *d d* is extended on each side of the shank, far enough to receive two bolts through each of these extensions, which bolts hold firmly together the two pieces of timber which form the stock, and secure the stock fast to the shank. Two iron hoops, fig. 8, *e e*, are driven on the stock between the bolts, and *f f f f* are other hoops, and *g g g g* are tree nails to strengthen the whole.

DESCRIPTION OF AN IMPROVED TELEGRAPH.

BY MAJOR CHARLES LE HARDY *.

HAVING discovered a mode of communicating by signals, which to me seems to unite every advantage that can be expected for that mode of communication, I beg leave to transmit to you a plan of it, and to write a few explanatory lines upon the subject.

The telegraph, of modern invention, is an improvement on communication by signals, which has been in use for many ages. Monsieur Chappe was, I believe, the first who proposed a machine for that purpose, which was put in execution about the year 1793. Since that time, several modes have been

* From *Transactions of the Society for the Encouragement of Arts, Manufacture, and Commerce*, for 1808.——The silver medal of the Society was voted to Major Charles Le Hardy for this communication.

proposed by different persons, none of which seem to have fully attained the object. A machine of this kind should be simple, and easy to comprehend. All those which have come to my knowledge are executed by combinations, which render them too complicated for common use, and therefore liable to many errors. That which I now submit to your consideration, seems to me to have removed every objection of the kind; it is simple, easy to comprehend, and extensive in its means; its combinations, which by simple numeration may be carried to 40,000, might with ease be extended to almost infinite numbers; but the present seems sufficient to answer every purpose. All the words in Entick's Dictionary amount to about 25,000; every one of which may thus be numbered. With how much more dispatch would a letter be communicated by signals which express words, than by signals which express only letters! Words may be forwarded as fast as they can be looked for in a dictionary; and even whilst only an equal number of letters could have been communicated by the present mode. Another advantage resulting from the use of words in telegraphic correspondence is, that the words of the same meaning in the several languages having the same number, correspondence may be carried on from one language into another, which though not grammatically correct, yet would be sufficiently intelligible.

Proper names must be spelt, which may easily be done, every letter having a corresponding number.

Though the use of telegraphs has to this time been confined to military purposes, yet a machine of this kind is well adapted to accelerate commercial communication from one end of the kingdom to the other. The arrival, the departure of vessels, the various transactions of commerce, might be speedily announced, to the very great advantage of trade. By this method inaccessible places might communicate their wants, and correspondents, though at a distance of five or six miles, might erect them for a trifling expence. I made the experiment with one of eight feet by ten, and, with the use of a telescope, I took down every number from a distance of a mile and a half.

Reference to the Engraving of Major CHARLES LE HARDY'S *Telegraph.* *See* Plate II. Figs. 1, 2, 3, and 4.

This machine is intended to express numbers, which may be seen at a distance, and to which words may be referred at pleasure.

Fig. 1 represents a front view of the machine—it is composed of nine bars or radii, answering to the nine figures of arithmetic, as numbered in the plate. The four polygonal

or concentric bars, A. B. C. D. which intersect the radii, are for the decimals; thus A stands for units, B for tens, C for hundreds, D for thousands. Over each of these concentric bars or circles, an index, as that marked H, fig. 2, traverses, which marks the number of thousands, of hundreds, of tens, and of units, as far as ten thousand; for instance, if it is required to make the number 9202, turn the hand H in the circle D of thousands to the radius 9, then the hand H in the circle C of hundreds to the radius 2, then, as there are no tens, turn the hand to the radius 2, upon the circle A of units; but as ten thousands are not sufficient to express the number of words in the English language, two square boards are added in the corners, of which that marked E is equal to 10,000, that marked F to 20,000, and both being shown together, are equal to 30,000, which, with the numbers made on the circles, bring it up to 40,000, which number is more by many thousands than all the words in the English language.

Fig. 2. is a view of the mechanism which works the signals round: this is done by means of a rack wheel at I, upon which is firmly fixed the hand with its signal board H; this wheel is made to revolve by means of a rack L, which being raised or lowered, makes it go backwards or forwards; this rack is set in motion by the pinion K, to which is fixed a winch, as M, fig. 3. To prevent the necessity of inspecting the signals, the wheel I, to which is fixed an index, as at N, fig. 4, is added, which revolving in the same time as the signal board H, marks the number of the decimal, so that it may be worked correctly from within doors. O, fig. 4, is a bolt to stop the hands at any given point, by means of a wheel with four notches Q fixed to the pinion. Fig. 3, is a side section of the machine, the lines *a a a a*, represent boards, upon each of which is fixed the mechanism, fig. 2. *b b b b*, are the hands and signal boards, one of which is shown at H, fig. 2. The square boards E and F, fig. 1, are fixed upon iron bars which pass through the bars or radii 4 and 6, and have each of their ends to move in holes in the radius 5, and in the frame at *i i*, fig. 1, upon which they turn a quarter round, by means of cross bars at *g g*, to each end of which ropes or wires *h h* are fastened, and which are connected with two levers, one of which is shown at P, fig. 3, the raising or depressing of which makes them appear or disappear as required.

METHOD OF RAISING LARGE STONES OUT OF THE EARTH.

BY MR ROBERT RICHARDSON *.

I, Robert Richardson, of Keswick, in the parish of Crosthwaite, and county of Cumberland, beg leave to inform you, that I have found out a method of taking large self-stones out of the ground in a very expeditious manner, and that by this means two men will take as many stones out of the ground in one day, as would require twelve men in the usual way of blasting, and afterwards using large levers, &c.

Where stones, of from two to four tons each, are to be taken up, two men will raise as many as twenty men in the usual way. The work is done by the power of a tackle, but by my method of fixing the tackle to the top of the stone, by the plug which I have invented, it will hold till the stone is pulled out of the ground, and laid upon the surface, or upon a carriage, if required, all which can be done in a very little time.

Stones of four tons weight, or upwards, may be taken out of the ground within the time of five or ten minutes, by two men, without any earth or soil being previously taken from around them, or without any digging with hacks or spades. J. C. Curwen, esq. of Workington, has seen and approved of my performance with this invention, and if the Society should think it deserving of a premium, it would ever be gratefully acknowledged.

I cannot suffer Mr Richardson's letter to be sent to the Society without adding a few lines concerning it. I can bear ample testimony to the ease with which the largest self-stones are lifted by his method. I have seen one upwards of five tons lifted by four men. One of the plugs is sent for the inspection of the Society. There is no difficulty in cutting the hole to receive it, the only care is not to make it too large. It is difficult to explain the theory of its action; the least stroke laterally disengages the stone. In many situations it is likely

* From *Transactions of the Society for the Encouragement of Arts, Manufactures, and Commerce*, for 1808.——The silver medal of the Society was voted to the inventor, and one of the implements is preserved in the Society's Repository.

to be of great use, not only in drawing stones out of the ground, but in making weirs and embankments, where the stones are only to be lifted a moderate height.

One of my farmers in Westmoreland has made great use of one, and speaks of it in high terms. I have exhibited it to numbers of persons, who could not believe its power till they saw it tried.

Mr Richardson submits its examination to the Society, and I conceive it will be very useful and beneficial in cases of new inclosures of land. I do not think it would answer for soft stones, or be safe to use for raising stones in buildings, it being so easily disengaged by any lateral blow. By adding wheels to the tackle machine, or having it upon a sledge, a great deal of time and trouble would be avoided. I purpose to employ this method next summer in making an embankment against the sea; the facility it will give in raising and removing large stones, will expedite the work greatly. If any further certificates of the performance of this plug be required by the Society, I will with pleasure transmit them to you. I will answer for its extracting any stone not exceeding five tons weight out of the ground, without any previous moving of the earth; and it is of importance to preserve large stones entire. J. C. CURWEN.

I am favoured with your letter, desiring my opinion of the utility of the iron plug invented by Robert Richardson, of Keswick. That which I use is about six inches long, and one inch and a quarter in diameter; it requires a hole of its own size, only two inches deep; the plug is to be driven in a little short of the bottom, and will raise a stone of six or eight tons, with the assistance of three men, in the course of ten minutes after the hole is prepared; and I do not hesitate to say, that three men thus furnished, will clear the ground of large stones in less time, and more effectually, than twelve men by any other method come to my knowledge. The plug should be made of good beaten iron. The simplicity and cheapness of the whole apparatus is a great object, as a good plug of the size I use will only cost two shillings and sixpence. I am fully of opinion, that by adding more and stronger ropes and pulleys, work might be done by it to an amazing extent. I have reaped great advantage in my farm from the aid of the iron plug, and, in justice to the inventor, am happy in thus vouching for its extreme usefulness. Several of my respectable neighbours have experienced the aid

and benefit of the above instrument, and will vouch, if required, for the truth of the above statement.

ROBERT WRIGHT.

Reference to the Engraving of MR RICHARDSON'S *Invention for raising large Stones out of the Earth.* *See* Plate III. Figs. 1, 2, 3, & 4.

In fig. 1, K shews the upper part of a stone nearly buried in the earth, having a hole made in it three inches and a half deep, and one inch in diameter, by means of a miner's jumper; the cylindrical tail of the plug *a*, figs. 2, 3, and 4, which is of the same size, is driven fast into it, by means of a hammer applied upon the head of the plug at G. This plug, in its whole length, is nine inches, and has a hole made in its broad part H, through which the oval iron ring B passes easily, and on which the plug can move backwards and forwards, when the ring is hung upon the hook of the lower pulley block of the lifting tackle. CCCC represent the four legs or frame-work of the quadrangle; D a fivefold tackle, with blocks ten inches in diameter; E a roller seven inches in diameter, turned by two long iron levers b b; the handle I is used as a safeguard, and to assist to regulate the power of the levers. In fig 1, the plug A is shown fixed in the stone K, ready to draw it out of the ground, by means of the lifting tackle.

N. B. The hinder legs of the quadrangle are made to close in between the fore legs, for the convenience of carriage.

INVENTION OF ARTIFICIAL WINGS.

BY M. DEGEN.

Mr Degen, a watchmaker of Vienna, has invented a machine for raising a person into the air. It is formed of two kinds of parachutes of taffeta, which may be folded up or extended at pleasure, and the person who moves them is placed in the centre. M. Degen has made several public experiments, and rose to a height of 54 feet, flying in various directions with the celerity of a bird. A subscription has been opened at Vienna to enable the inventor to prosecute his enquiries.

MACHINE FOR TRAVELLING UNDER WATER.

BY BARON LUTGENDORF.

Baron Lutgendorf, long known as a traveller and voyager, has contrived a machine by which a person may exist under water, without fear of being drowned; it is a kind of cuirass, which admits of the body assuming every possible position, and which is said to be extremely useful in saving persons in danger of being drowned. The police of Vienna have purchased a considerable number of these machines, with the view of assisting in bringing up drowned persons from the bottom of the Danube.

PLAN FOR PREVENTING OR SUPPRESSING FIRES.

BY MR K.

Suppose a building to be nominally divided into convenient sections, each capable of being and actually attended to by one watchman. A small chamber, or any other space, in addition to and distinct from these, in a proper situation, should be occupied by a person to direct or check these watchmen. The direction may be exercised ordinarily without leaving this chamber, in the following manner: Let there be one clock for each watchman, of a certain construction (which is at present partially in use, and proved to accomplish purposes similar to the object of the present paper) fixed in the chamber of the director of the watchmen; each clock communicating with the section of its proper watchman by cranks and wires, or otherwise, in such a manner, that by pulling the wire he shall be able to effect a visible alteration on the clock at a precise moment, as agreed upon, conformably with the construction of the clock, but not any other moment. This clock shows the usual division of time, and has also re-revolving frame in which pins are placed in sockets capable

of being pressed down at particular times only, as above stated. Thus, by the use of this clock, a watchman's vigilance or neglect may be proved by the evidence of the clock itself.

Suppose, for example, this clock be so constructed, that a pin shall be pressed down every quarter of an hour, and the proof of its being done shall rest with the director of the watchmen, in the first instance, simply by looking at the clock every quarter of an hour; it is evident, that the neglect of a watchman cannot exist longer than this space of time, if the director fail not in his duty. This man should himself be watched with the most scrupulous suspicion, and detected in his own failure, in the same manner as he should detect the failure of the watchmen, that is, by the proof of a clock on the same principle as the above, placed on the outside of the building, and under the absolute examination of the police, or any other superintendance satisfactory to those most interested. If the director be correct, instant alarm would be led to the section of any watchman whose duty should appear to be neglected; and if the director be incorrect, the alarm would be ulterior, and as active as in the case of positive danger. It may be thought difficult for one man to examine many clocks at the same moment: if it should be found so, each clock might be set differently, and every watchman have a clock in his section set by his proper clock in the director's chamber.

Hence, in case of fire, a discovery would not only soon take place, but personal assistance would be on the spot, and, with proper access to water at all times ensured, with the best means of applying it, an increase of the first evil would almost certainly be prevented, until additional assistance could be procured: and alarm bells or other signals, by the sound or character of which the particular building might be made known to firemen, could, if necessary, be instantly sounded or displayed, and a constant influx of proper persons would take place in the very infancy of danger.

CHEMICAL ARTS.

AN ACCOUNT OF SOME EXPERIMENTS, PERFORMED WITH A VIEW TO ASCERTAIN THE MOST ADVANTAGEOUS METHOD OF CONSTRUCTING A VOLTAIC APPARATUS, FOR THE PURPOSES OF CHEMICAL RESEARCH.

BY JOHN GEORGE CHILDREN, ESQ. F.R.S.*

The late interesting discoveries by Mr Davy having shown the high importance of the Voltaic battery as an instrument of chemical analysis, it became a desirable object to ascertain that mode of constructing it, by which the greatest effect may be produced, with the least waste of power and expense.

For this purpose I made a battery, on the new method, with plates of copper and zinc, connected together by leaden straps, soldered on the top of each pair of plates; which are twenty in number, and each plate four feet high, by two feet wide: the sum of all the surfaces being 92160 square inches, exclusive of the single plate at each end of the battery. The trough is made of wood, with wooden partitions well covered with cement, to render them perfectly tight, so that no water can flow from one cell to another. The battery was charged with a mixture of three parts fuming nitrous, and one part sulphuric acid, diluted with thirty parts of water, and the quantity used was 120 gallons.

In the presence, and with the kind assistance of Messrs. Davy, Allen and Pepys, the following experiments were made:

Experiment 1. Eighteen inches of platina wire, of $\frac{1}{30}$th of an inch diameter, were completely fused in about twenty seconds.

* From Philosophical Transactions for 1809, Part I.

Exp. 2. Three feet of the same wire were heated to a bright red, visible by strong day-light.

Exp. 3. Four feet of the same wire were rendered very hot; but not perceptibly red by day-light. In the dark, it would probably have appeared red throughout.

Exp. 4. Charcoal burnt with intense brilliancy.

Exp. 5. On iron wire, of about $\frac{1}{10}$th of an inch in diameter, the effect was strikingly feeble. It barely fused ten inches, and had not power to ignite three feet.

Exp. 6. Imperfect conductors were next submitted to the action of the battery, and barytes, mixed with the red oxide of mercury, and made into a paste with pipe-clay and water, was placed in the circuit; but neither on this nor on any other similar substance was the slightest effect produced.

Exp. 7. The gold leaves of the electrometer were not affected.

Exp. 8. When the cuticle was dry, no shock was given by this battery, and even though the skin was wet, it was scarcely perceptible.

Before I offer any observations on the inferences to be drawn from these experiments, I shall mention some others, performed, for the sake of comparison, with the foregoing, with an apparatus very different in size and number of plates from the one described.

This second battery was precisely the *Couronne des Tasses* of Sig. Volta, consisting of two hundred pairs of plates, each about two inches square, placed in half pint pots of common queen's ware, and made active by some of the liquor used in exciting the large battery, to which was added a fresh portion of sulphuric acid, equal to about a quarter of a pint to a gallon.

To state as shortly as possible the effects produced by this battery:

Experiment 1. It decomposed potash and barytes readily.

Exp. 2. It produced the metallization of ammonia with great facility.

Exp. 3. It ignited charcoal vividly.

Exp. 4. It caused considerable divergence of the gold leaves of the electrometer.

Exp. 5. It gave a vivid spark, after being in action three hours. At the expiration of twenty-four hours, it retained sufficient power to metallize ammonia, and continued, with gradually decreasing energy, to produce the same effect till the end of forty-one hours, when it seemed nearly exhausted.

From the results of the foregoing experiments, which,

though simple and not numerous, I trust, are satisfactory, we see Mr Davy's theory of the mode of action of the Voltaic battery confirmed: he says (in his Paper on some Chemical Agencies of Electricity, sect. 9, after having shown the effect of induction to increase the electricity of the opposite plates), "the intensity increases with the number, and the quantity with the extent of the series."

That this is so, the effects produced on the platina and iron wires, in the first and fifth experiments with the large battery, and the subsequent experiments on imperfect conductors, with the small apparatus, sufficiently prove. The platina wire being a perfect conductor, and not liable to be oxidated, presents no obstacle to the free passage of the electricities through it, which, from the immense quantities given out from so large a surface, evolve, on their mutual annihilation, heat sufficient to raise the temperature of the platina to the point of fusion.

With the iron wire, of $\frac{1}{10}$th of an inch diameter, the effect is very different, which is explained by the low state of the intensity of the electricity (sufficiently proved by its not causing any divergence of the gold leaves of the electrometer), which being opposed in its passage by the thin coat of oxide, formed on the iron wire, at the moment the circuit is completed, a very small portion only of it is transmitted through the wire. To the same want of intensity is to be attributed the total inability of the large battery to decompose the barytes, and its general weak action on bodies which are not perfect conductors. The small battery, on the contrary, exerts great power on imperfect conductors, decomposing them readily, although its whole surface is more than thirty times less than that of the great battery; but in point of number of plates, it consists of nearly ten times as many as the large one. The long continued action of the small battery proves the utility of having the cells of sufficient capacity to hold a large quantity of liquor, by which trouble of emptying and filling the troughs is avoided, and the action kept up, without intermission, for a long space of time,—a circumstance, in many experiments, of material consequence. Besides this advantage, with very large combinations, a certain distance between each pair of plates is absolutely necessary, to prevent spontaneous discharges, which will otherwise ensue, accompanied with vivid flashes of electric light, as I have experienced, with a battery of 1250 four-inch plates, on the new construction. And here I beg leave to mention an experiment, which, though not directly in point, cannot be considered as foreign to the sub-

ject of this paper. It has been urged, as one proof the nonidenty of the common electricity, and that given out by the Voltaic apparatus, that in the latter there is no striking distance. That objection, however, must cease. I took a small receiver, open at one end; through perforations in the opposite sides of which were placed two wires, with platina points, well polished: one was fixed by cement to the glass, the other was moveable, by means of a fine screw, through a collar of leathers, and the distance between the points was ascertained by a small micrometer attached. This receiver was inverted over well dried potash over mercury, and suffered to stand a couple of days, to deprive the air it contained, as thoroughly as possible, of moisture. The 1250 plates being excited precisely to the same degree as the great battery, mentioned in the beginning of this communication; and the little receiver placed in the circuit, I ascertained its striking distance to be $\frac{1}{50}$th of an inch. That I might be certain that the air in the apparatus had not become a conductor by increase of temperature, I repeated the experiment several times with fresh cool air, and always with the same result; but perhaps it will be objected, that the striking distance was so small, as not to afford a satisfactory refutation of the argument alluded to, when it is considered to how very great a distance, comparatively, the spark of the common electrical machine can pass through air. The answer to this is obvious: increase the number of the plates, and the striking distance will increase; for we see throughout, the intensity proportioned to the number, and it probably may be carried to such extent, as even to pass through a thicker plate of air than the common spark. The great similarity of the appearance of the electric light of this battery in vacuo, and that of the common machine, might also be urged as an additional proof of the identity of their nature.

The effect of this large combination on imperfect conductors, was, as may be supposed, very great; but of the same platina wire, of which the four-feet plates fused eighteen inches, this battery melted but half an inch, though, had the effect been in the ratio of their surfaces, it should have fused nearly fourteen inches.

The absolute effect of a voltaic apparatus, therefore, seems to be in the compound ratio of the number and size of the plates: the intensity of the electricity being as the former, the quantity given out as the latter; consequently regard must be had, in its construction, to the purposes for which it is designed. For experiments on perfect conductors, very large plates are to be preferred, a small number of which will pro-

bably be sufficient; but where the resistance of imperfect conductors is to be overcome, the combination must be great, but the size of the plates may be small; but if quantity and intensity be both required, then a large number of large plates will be necessary. For general purposes, four inches square will be found to be the most convenient size.

Of the two methods usually employed, that of having the copper and zinc plates joined together only in one point, and moveable, is much better than the old plan of soldering them together, through the whole surface, and cementing them into the troughs: as, by the new construction, the apparatus can be more easily cleaned and repaired, and a double quantity of surface is obtained. For the partitions in the troughs, glass seems the substance best adapted to secure a perfect insulation; but the best way of all will be troughs made entirely of Wedgwood's ware,—an idea, I believe, first suggested by Dr Babington.

DESCRIPTION OF AN APPARATUS FOR MAKING CARBONATED HYDROGEN GAS FROM PIT COAL, FOR THE PURPOSE OF LIGHTING FACTORIES THEREWITH.

BY MR SAMUEL CLEGG. *

A gazometer, containing seven hundred cubical feet of gas, weighs about twenty hundred weight, and costs about two pounds ten shillings the hundred weight.

The whole of an apparatus complete, capable of supporting forty lamps for four hours, each lamp affording light equal to ten candles of eight in the pound, will cost about two hundred and fifty pounds. Each lamp consumes six cubical feet of gas per hour.

Fig. 1, Pl. V. *A* shows the cast iron retort, into which are put the coals intended to be decomposed by means of a fire underneath it, the heat of which surrounds every part of it, excepting the mouth or part by which the coals are introduced.

* From *Transactions of the Society for the Encouragement of Arts, Manufactures, and Commerce*, for 1808.——The silver medal of the Society was voted to the author.

The lid or iron plate *B*, which covers the mouth of the retort, is ground on air tight, and fastened by means of a screw in the centre; *C* is a shield or saddle of cast iron, to preserve the retort from being injured by the intensity of the fire underneath it, and to cause it to be heated more uniformly. *DDD* represents the cast iron pipe which conveys all the volatile products of the coal to the refrigeratory of cast iron *E*, in which the tar, &c. extracted from the coal is deposited, and from whence they can be pumped out by means of the copper pipe *F*. *G* is the pipe which conveys the gas to the top of the cylindrical vessel or receiver *H;* this receiver is air tight at the top, and consequently the gas displaces the water in the vessel *H*, to a level with the small holes, where the gas is suffered to escape and rise through the water of the well *I*, into the large gazometer *K*. The use of the vessel *H* is pointed out as follows, viz: if the pipe *G* reached all through the water, without passing into the vessel *H*, the gas would not be rendered pure or washed; and if part of the pipe did not rise above the water, the water would have free communication with the tar, besides exposing the retort *A* to a very great pressure, so as to endanger its bursting when red hot. This vessel or receiver *H*, in a large apparatus, is about eighteen inches diameter, and two feet long; the quantity of gas, therefore, which it contains, is sufficient to fill the pipes and retort when cool, and prevents the pipe *G* from acting as a syphon, and exposes the gas to the water without endangering the retort.

When the operation begins, the upper part of the cylindrical gazometer *K*, fig. 1, made of wrought iron plates, is sunk down nearly to a level with the top of the circular well *I*, and is consequently nearly filled with water, but it rises gradually, as the gas enters it and displaces the water; the two weights *LL* suspended over pulleys by chains keep it steady and prevent its turning round, otherwise the lower stays *M* of the gazometer would come into contact with the vessel *H*. There are two sets of these stays, one shown at *M*, and the other at *N*.

There is also an iron pipe *O* made fast in the centre of the gazometer by means of the stays, which slides over the upright pipe *P*, by which contrivance the gazometer is kept firm and steady, when out of the well; it likewise prevents the gas from getting into the cast iron pipe *P*, and the copper pipe *R*, any where but through small holes made in the pipe *O* at *S* at the top of the gazometer, where the gas is perfectly transparent and fit for use.

The pure gas enters the tube *O* at the small holes made in its top at *S*, and passes on through the tubes *P* and *R* to the lamps, where it is consumed and burnt.

The seams of the gazometer are luted to make them air tight, and the whole well painted inside and out, to preserve it from rust.

Fig. 2. shows a horizontal section of the lower hoop of the gazometer *K* at the part *M*, with its stays or arms, and the manner in which the iron pipe *C*, before described at fig. 1, sliding on the tube *P*, passes through the ring in the centre of the hoop; a horizontal section of the receiver *H* appears therein.

Fig. 5. shows a section of one of the gas lamps; the space between the outer tube *T* and the inner tube *V*, is to be filled with gas supplied by the pipe *R*, shown in fig. 1, where a stop cock is inserted for adjusting the flame, which gas passes through a number of small holes made in the outer edge of a circular plate shown at fig. 6, which unites the tubes *T* and *V* at their tops. *V* is the inner tube which conveys the atmospheric air into the centre of the flame; the upper part of this tube is made conical, or widening outwards, to join a circular plate with holes in it, a horizontal view of which is shown at fig. 6. *W* is a button, which can be placed at a small distance above the mouth of the lamp, and its use is to convey, in an expanded manner, all the air which rises through this tube to the inner surface of the flame, which assists the combustion very much; this button may be set at any convenient distance above the tubes of the lamp, as it slides in the cross bars *XX*, by which it is supported in the inner tube.

A current of air also passes between the glass tube or chimney and the outer tube *T*, through holes made in the bottom of the glass-holder, as in Argand's lamps; this surrounds the flame, and completes its combustion, as explained by the view, fig. 3, and section, fig. 4, which have a glass upon each. *ZZZZ*, figs. 3, 4, 5, and 6, show the tube through which the lamp is supplied with gas from the pipe *R*, fig. 1.

ANALYSIS OF THE ENGLISH MEDICINE CALLED JAMES'S POWDER.

BY M. PULLY *.

James's powder is greatly in vogue both in England and Italy. The English make a secret of it, and sell it for its weight in gold † as a sovereign remedy in asthenic diseases, and fevers attended with debility. Dr Pearson, an English chemist, informs us, that he has analysed it; and that this powder is a triple salt composed of phosphate of lime and oxide of antimony. Those chemists, who have attempted to compose James's powder according to Dr Pearson's recipe, have no doubt been astonished at their want of success. They must suppose, that the English physician, not to betray a secret from which his country profits, has not disclosed the whole truth ‖; and in fact James's powder contains, besides, sulphate of potash and antimoniated potash.

Mr Pully, a Neapolitan chemist, who has rendered great services to the army of Italy as administrator of gunpowder and saltpetre, writes me word, that he has just analysed this powder, of which he procured from London a sufficient quantity to subject it to a strict examination. The following are the particulars of his experiments.

Exp. 1. I took, says Mr Pully, some James's powder, of which I weighed out 19 decigr. [29 grs.] After infusing it a few minutes in a little warm distilled water, I filtered off the water, and obtained from it by evaporation a salt, that had all the characters of sulphate of potash. This salt, dissolved and treated with barytes, afforded a precipitate of sulphate of barytes.

Exp. 2. As I perceived, before I decomposed the salt by means of barytes, that the solution contained an excess of free potash, I wished to ascertain, whether this potash did not hold in suspension a little oxide of antimony. In fact, having decanted the fluid, to separate it from the sulphate of barytes, I poured into it some sulphuretted hydrogen, which immediately

* Annales de Chimie, Vol. LV, 74.

† The foreign venders appear to get a good profit on it, as the original price here is not above a fourth of this.

‖ Dr Pearson certainly concealed nothing in his analysis.

formed golden sulphur of antimony. The free potash, therefore, was combined with a portion of antimony at a minimum of oxidation. Dr Pearson does not speak of this combination, or of the sulphate of potash.

Exp. 3. I took the James's powder, which had been washed with warm distilled water, and heated it with nitric acid of the strength of 20°. This acid dissolved the phosphate of lime, without attacking the oxide of antimony at a maximum. I separated this oxide from the solution, and poured into the liquor some ammonia, which precipitated the phosphate of lime.

Exp. 4. I decomposed the phosphate of lime with diluted sulphuric acid, and afterward recomposed it by means of lime water, in order to ascertain the proportions.

Exp. 5. I took the oxide of antimony at a maximum of oxidation, and dissolved it in muriatic acid. This solution, treated with sulphuretted hydrogen, produced a hydrosulphuret of antimony, containing more sulphur than kermes mineral, and less than the golden sulphur.

From these experiments, all the products of which I weighed, the 19 decigr. of James's powder, which I analysed, are composed of

	Parts.
Oxide of antimony at a maximum of oxidation	7
Phosphate of lime	4
Sulphate of potash	4·7
Free potash, holding oxide of antimony at a minimum	3·5
	19

To recompose this powder we must take

	Parts.
Sulphuret of antimony	4
Calcined phosphate of lime	3
Nitrate of potash	8

These being powdered, mixed, and triturated together, they are put into a crucible, which is to be covered, and exposed to a strong heat. During this operation, the oxigen of the nitric acid, attacking the sulphur of the antimonial sulphuret, converts it into sulphuric acid, which unites with a portion of the potash, and forms sulphate of potash. The remainder of the free potash retains some antimony oxided to a minimum. The white powder, that is left in the crucible, is the same as that sold so dear by the English.

Mr Pully informs me, that he has analysed his powder,

to compare it with that of Dr James; and that he has found it to contain the same principles, and in the same proportions.

ON THE PURIFICATION OF CAMPHOR BY MEANS OF POTASH.

A gentleman has found that, when camphor is sublimed with a small admixture of pure potash, its oily particles and empyreumatic smell are detained by the alkali.

A NEW METHOD FOR DETECTING ARSENIC.

BY JOSEPH HUME, ESQ.

Let one grain of white oxide of arsenic, and the same quantity of carbonate of soda be dissolved by boiling, in ten or twelve ounces of distilled water, which ought to be done in a glass vessel; to this let a small quantity of the nitrate of silver be added, and a bright yellow precipitate will instantly appear. This is a more decisive test than sulphate of copper, which forms Scheele's green (arseniate of copper); and though my process answers very well with potass, or even lime water, yet I am inclined to prefer the common subcarbonate of soda.

OBSERVATIONS ON SULPHURIC ETHER, AND ITS PREPARATION.

BY M. BOULLAY, APOTHECARY OF PARIS.*

The use of sulphuric ether is at present very extensive, and its consumption so great, that it has become a produce of

* Annales de Chimie, vol. LXII, p. 242.

the arts in the large way. Its preparation, though much simplified, still merits attention; and appears capable of being improved, not only in respect to economy, but also as to the purity of the product.

In the formation of sulphuric ether, whether by the distillation of a simple mixture of concentrated sulphuric acid and alcohol, or the addition of fresh alcohol to the residuum, all the quanity obtained is not equally dulcified; and, in spite of careful rectifications, the last portions always retain a more or less unpleasant smell, that may be ascribed to some oil intimately united with it, which it is very difficult to separate completely.

According to the theory of Messrs. Fourcroy and Vauquelin, founded on their learned researches into the subject, the attraction of sulphuric acid for water, assisted by heat, determines the transformation of alcohol into ether. This reaction of the principles of alcohol, exerted under the influence of the sulphuric acid, precedes the carbonization of the mixture, the formation of the oleum dulce, the extrication of sulphuric acid, and the other phenomena of the process carried to its end. We may even venture to say, that ether is no longer formed, when these products appear; and that what passes over after that time is only separated from the residuum, in which it was contained ready formed. It would be an advantage, therefore, to prevent, or at least retard, the appearance of these products, which announce a complete decomposition of the alcohol; and, by adding at a proper time fresh quantaties of this liquid, to keep up such proportions, that the etherification may go on much longer. For this it appears necessary, that the sulphuric acid should never compose more than two thirds of the contents of the retort, and that the alcohol should be scarcely ever less than the other third *. In this way the sulphuric acid is prevented from burning the alcohol to its loss, and we obtain none of the results of a decomposition carried too far, which is injurious to the etherification, and immedidiately follows it. We shall then have a better product, and in larger quantity; and the production of ether will continue, till the sulphuric acid is so much diluted by the water formed and separated, as to be unable to effect any change in the alcohol.

* The proportions of equal parts of sulphuric acid and spirit of wine, constantly adopted, appear to be most suitable. It is to be observed, however, notwithstanding the utmost care taken to separate the alcohol, that comes over first, the product that follows does not attain the lightness, that constitutes true ether, till toward the middle of the process.

The particular kind of funnel, which has facilitated my making ether by means of the phosphoric acid, and is applicable to many other chemical processes, enabled me to carry this theory into practice in the following manner:

To a large tubulated glass retort, glaced on a sand heat, I adapted a glass worm immersed in a vessel of cold water. The extremity of the worm was inserted into the neck of a large bottle, between which and a second bottle filled with water a communication was established by means of a siphon. Into the retort I introduced ten kilogrames [22lbs. avoird.] of sulphuric acid concentrated to 66°. In the tubulure was inserted the funnel with two cocks, so that its pipe descended nearly to the bottom of the retort, passing through the sulphuric acid. Ten kilogrammes of alcohol at 36°. of Beaumé's aerometer were then poured in quickly, being conveyed through the acid by means of the funnel. The mixture was very well effected, though with violence; and it was the less coloured in proportion as the introduction of the alcohol was more speedy. The distillation was kept up by means of a fire under the retort; and as soon as about two kilogrammes had passed over, ten kilogrammes of fresh alcohol at 40° were introduced drop by drop, regulating the quantity as nearly as possible by what passed over into the receiver. The process was continued so as to obtain fifteen kilogrammes of a white limpid product, of the most agreeable ethereal smell and taste, containing no traces of sulphurous acid or oleum dulce, and yielding, when rectified on a water-bath, eight kilogrammes of pure ether, with some alcohol of an ethereal smell well adapted for future processes.

The liquid remaining in the retort was of the colour of beer, and very clear. It consisted of nearly the whole of the sulphuric acid employed, some alcohol, water, and no doubt a certain quantity of ether completely formed.

This residuum, heated afresh, quickly assumed a black colour, and became sulphurous and oily. In this state it may enter into the composition of Hoffmann's mineral anodyne liquor. The residuum might also be turned to account, by using it as sulphuric acid where the alcohol could do no harm, as for instance, in forming different salts.

ON THE CONVERSION OF MALT SPIRIT INTO VINEGAR, AND ON THE RED COLOUR OF OIL OF HEMPSEED *.

IN A LETTER FROM M. RESAL TO M. CADET.

I take the liberty of imparting to you an observation respecting the article of Mr Herbert of Berlin, whose process you could not verify without it. I communicated it to Mr Parmentier twelve months ago, with several other notes, part of which was inserted in the month of May, 1806. One of these was on the vinegar of brandy, which chance threw in in my way. I had mixed some malt spirit (*alcohol de bierre*) with an equal quantity of water, and added to it some beech charcoal. Being set aside and forgotten, I was surprised at the end of a twelvemonth to find it converted into a very strong vinegar, and the unpleasant taste of the beer still subsisting.

With your permission I will add an observation respecting the property of liquids to absorb different solar rays.

It is known that various substances absorb this or that luminous ray, but I do not believe that any one has mentioned the property, that oil of hempseed, *cannabis sativa L.*, has to absorb the red rays when they are direct only, and to appear of a fine blood-red colour; so that, being lighter than rape or linseed oil, as it returns to the upper part of the vessel it appears equally red, without changing the colour of the oil it floats on. Its use in the arts, since it offers more resistance to the air than linseed oil, and does not skin (*ne se crispe pas*) like it; and its mixture with oils for the lamp being very common from its low price, while it yields a thick smoke; require a method of detecting it. This that I have mentioned perhaps would answer, and even shew the effect of the solar rays on different substances.

* Annales de Chimie, vol. LXIV, p. 261.

MODE OF RECOVERING SOUR WINE.

BY M. CREVE.

Mr Creve of Wisbaden has discovered a method of recovering wine that has turned sour. For this purpose he employs powdered charcoal. The inhabitants of the banks of the Rhine have bestowed on him a medal, as a reward for this discovery.

METHOD OF PAINTING LINEN CLOTH IN OIL COLOURS, TO BE MORE PLIANT, DURABLE, AND LONGER IMPERVIOUS TO WATER THAN THE USUAL MODE.

BY MR WILLIAM ANDERSON, OF HIS MAJESTY'S DOCK-YARD, PORTSMOUTH*.

Having never heard or read of any method being discovered to prevent paint when laid on canvas from hardening to such a degree as to crack and eventually to break the canvas, and render it unserviceable in a short time; and having been an eye-witness for many years of much canvas perishing for want of such discovery, in the immense quantities painted for covering seamen's hammocks, and for other uses on board his Majesty's ships; I long had it under consideration to find out such an ingredient as, when mixed with paint, would preserve the canvas and paint laid thereon from the damages above-mentioned: and after experiments for a considerable time, I have discovered such an article, and made trial of it with effect above three years.

* From *Transactions of the Society for the Encouragement of Arts, Manufactures, and Commerce*, for 1807. ——The silver medal of the Society was voted to Mr Anderson for this communication.

The canvas I have painted has been submitted to the inspection of the Navy Board, who are so perfectly satisfied with my new method, that general directions are now given to paint all canvas in his majesty's dock yards in this manner; which, in addition to the advantages I have before mentioned, actually saves an expence of one guinea in every hundered square yards of canvass so painted, as I have fully stated to them. The ingredient I use is not only serviceable for ships' canvas, but also for canvas designed for paintings, for floor-cloths, and for painted coverings within and without doors. I have no doubt of it being applied to many other purposes I am yet unacquainted with; as, from actual trials of near four years, I can vouch for its being a preservative to red, yellow, and black paints, when ground in oil and put in casks. When the paints were examined at the expiration of such time, they discovered no improper hardness; but when laid on the work with a brush, they dried in a remarkable manner, without the addition of any of the usual drying articles. I still preserve some of these paints for future trials, and I believe this plan of preserving colours will be of essential use to colourmen, and other persons who purchase colours for exportation. The ingredient I use is perfectly simple, being a solution of yellow soap; and the composition for painting is made in the following manner.

To one pound of soap I add six pints of water in a vessel over the fire; in a few minutes after the boiling of the water the soap will dissolve; whilst hot it is to be mixed with oil paint, prepared as hereafter directed, and is then fit for immediate use. The above quantity of soap solution will be sufficient to mix with one hundred weight of paint. The first coat to be laid upon the canvas is to be entirely of this composition, without first wetting the canvas in the usual way. A very small proportion of it, or none, is necessary in the second coat; and the third coat should be of oil paint alone.

The method heretofore practised in his majesty's dock-yards for painting canvas, was as follows. The canvas was first wet with water, then primed with Spanish brown; a second coat given it of a chocolate colour, made from Spanish brown and black paint; and, lastly, finished with black. This mode is destructive, and more expensive than mine in the proportion before mentioned. In my method, to ninety-six pounds of English ochre ground in boiled oil, I add sixteen pounds of black paint, being one-sixth in proportion of the ochre; this, when mixed, forms an indifferent black. The solution, made of one pound of soap and six pints of water, is to be added to

this paint, and well united therewith; and without the canvas being previously wet, this composition is to be laid upon the canvas as stiff as can conveniently be done with the brush, and this first coat will form a tolerably smooth surface. The second coat is to be formed of the same proportion of English ochre and black, without any soap solution; and the third or finishing coat, to be done with black paint as usual.

I have also discovered a method of obtaining from painted canvas, unserviceable, the whole of the colour laid thereon, and to do it at a very small expence, and I believe it will be of considerable advantage to government, which, for want of such a thought, have buried and burnt immense quantities of ships' hammock cloths, when found unserviceable, to prevent embezzlement from taking place. I suggested the idea to N. Diddems, esq. builder of Portsmouth yard, who communicated it to the honourable George Grey, commissioner. I obtained leave to make an experiment, which I repeated thrice, and found that from one ton of painted canvass, unserviceable, I obtained, upon an average, four hundred weight of dry colour, in value to government nine pounds six shillings; the expence of the process not exceeding six shillings.

This I effected by calcination, raking aside the ashes and sprinkling them with water, to prevent loss of paint through excess of heat. By passing the calcined matter through a fine sieve, it is perfectly prepared for grinding; it grinds well, possesses a good body for covering with, and dries well with a good gloss. Its increase of bulk, in comparison with common colour of equal weight, gives it the advantage of covering more work. The colours yielded by the calcination of different coloured canvas are as follows, viz. Canvas which has been painted with black paint only, produces a black colour. Canvas finished black, but which has had a previous red or yellow ground, will produce a dark chocolate colour. Canvas pointed lead colour will yield a good dark lead colour.

Certificates, dated March, 1807, were received from the following persons, viz.

A. Stow, lieutenant and commander of the gun-brig Steady, stating, that in the preceding month of October he had received on board his ship a set of hammock cloths, painted after the method invented by Mr William Anderson, which had been constantly in use since the time above mentioned, and appeared fully to answer the end proposed, of rendering the canvas soft and pliable, of preventing its cracking, or the paint peeling off, and which in the old method had been a subject of much complaint.

John Pridy, lieutenant and commander of the Gladiator, and formerly commander of the Dapper, on which latter ship a set of hammock cloths, painted after Mr Anderson's method, appeared fully to answer the end proposed.

P. F. Wyatt, oil and colour man, Portsea, stated that he had seen canvas painted after Mr Anderson's new method, which, after a trial of sixteen months, remained perfectly soft and pliable, the paint by no means cracking or peeling off, and that the gloss was retained, though it had been exposed to all weathers. He further added, that he had seen the paint prepared by him from old painted canvas found unserviceable, and had worked and painted therewith; that it was, in his judgement, very good, and would answer either on canvas, wood, or iron.

Ns. Diddems, master shipwright, Portsmouth dock-yard, stated, that Mr Anderson had proposed to him to obtain, by calcination, from old unserviceable painted canvas, the paint which had been laid thereon; that such experiment was made, and four hundred weight of dry serviceable paint prepared from one ton of such canvas; that he had seen it when ground in oil and laid on work, when it appeared to possess all the properties of good paint, and had therefore been recommended by him to the Navy Board.

The space of time, continues Mr Anderson, proper between laying on the new preparation and the second coat, ought to be one entire day; but if saving time is an object, the second coat may be put on the day following the first; for, if the canvas is placed in an advantageous situation for drying, the composition will dry or harden so as not to rub off.

Canvas finished entirely with the composition, leaving it to dry one day between each coat, will not stick together if laid in quantities, as you will find by making experiments.

Since the Navy Board have given directions for ships' canvas to be painted according to my method, I find, upon calculation, that I have painted upwards of twenty thousand yards since November last, a great part of which has not been hung up for painting and drying more than one week, as no more time could be allowed me, in consequence of ships sailing. My plan was therefore to lay on the composition the first day, to coat it the second day, and, leaving one intermediate day, to finish it on the fourth. Three days were then allowed it to dry and harden; and when afterwards taken down and folded to-

gether in cloths, containiug sixty or seventy yards, they did not stick together.

Having no means of giving information to persons concerned in grinding colours, so well as through the medium of the Society of Arts, &c. I beg leave further to relate how I have, for the last three years, saved the labour of three men out of four in grinding colours with the common mills employed for that purpose. One mill has ever been considered sufficient for a man to turn, whereas one man can now, with perfect ease turn four mills; this is effected by placing two mills on each side of the winch, so close as only to leave room for the fly wheel to play between them. The spindles of each on either side are locked together by a small iron collar, with a pin passing through it. The distance of the mills thus paired from each other, in order for the man's standing between them to turn, is two feet six inches. The distance of the arms of the winch screwed on the end of the spindles on either side, is two feet two inches; the length of the arm is one foot six inches from the spindles to the bar across which the man clasps in order to turn.

Fly wheels at the extremity are impediments. Necessity was truly the mother of invention to me in this case, as I had great demand for paint, and I was not allowed men sufficient for the work in the common way.

Persons will scarcely believe, without seeing the experiment, the ease with which they turn. If a little extraordinary motion is first given them, and they are then left alone, they will continue to go round sixteen times; so that a man with one hand may turn them.

I have stated to the Admiralty Board the several improvements made by me in paint work; and in consequence thereof they have desired the principal officers of our yard to report to them on their merits. The officers, who have for more than twelve months past daily had the execution of them under their inspection, have recommended the same in stronger terms, and the advantages thereof, to the lords commissioners, beyond my statement.

METHOD OF FABRICATING ARTIFICIAL STONE EMPLOYED IN THE VICINITY OF DUNKIRK.

BY MR BERTRAND *.

The materials employed for this purpose are the ruins of the citadel, consisting of bricks, lime, and sand. These are broken to pieces by means of a mill, formed of two stone wheels, following each other, and drawn by a horse. Water is added; and the matter, when well ground, is reddish. This is put into a trough, and kept soft by means of water.

When the trough is full, some lime is burned, and slacked by leaving it exposed to the air, and this is mixed in the proportion of one eighth with the cement above.

A wooden mould is laid on the stone, and after a thin layer of sand is thrown on the stone, to prevent the cement's adhering to it, a layer of cement is poured in, and on this a layer of bricks broken into acute-angled fragments. Thus two other strata are put in, before the last, which is of pure cement. The mould being removed, the stones thus formed are laid in heaps to dry. The lime being very greedy of water, and quickly becoming solid, these stones are not long in forming a hard body fit for building.

The lime is not very dear, being burned with pitcoal. The labour is not dear, requiring only one strong man assisted by two or three boys of twelve years old. The materials, being from old ruins, are cheap, and only one horse is employed in this manufactory, which is not the only one in the country. I believe others exist in Prussian Poland where these stones are made with much more success, because fragments of basaltes, which are better adapted to form a solid body with lime and alumine, are there used.

The pebbles of Boulogne would be still preferable, and I doubt not with these, artificial stone might be made equal to natural stone in goodness.

* Annales de Chimie, vol. LV, p. 285.

NEW PROCESS FOR HARDENING THE SURFACE OF PLAISTER CASTS.

A new process for hardening the surface of casts in plaister of Paris, has been communicated to the same Society of Arts. It consists in boiling the cast in a solution of one pound of alum in a pint of water for fifteen minutes, and then suffering it to dry gradually for about a month; in this way the cast acquires a very considerable degree of hardness upon its surface, and is even capable of receiving a polish by friction, so as to resemble white marble; and the surface of it may be cleaned from time to time, without the least injury to the sharpness of the cast.

AGRICULTURE, GARDENING, &c.

ON RECLAIMING WASTE LANDS.

BY MR WAGSTAFFE*.

As your influence for the enclosure of waste land is confessed, and, I conceive, extending within the scope of your Society, and it should now seem on the eve of a Parliamentary encouragement; I ask leave to recite an experiment I made on a portion of land, of as obvious sterility as perhaps any present waste within the western counties.

This was an acclivity, which had not been cultivated within memory; and at the foot of it a various tract, gravelly and moory, broken into hollow spaces, in which waters rested during the summer months, which waters were covered with

* Bath Papers, Vol. X. p. 18.

most of the aquatic plants native to stagnant pools. My predecessor in possession of these watery wastes, during a summer drought, fed their interstices with sheep, which became diseased, and many of them rotten.

The mode I pursued was as much as might be to extract the weeds, roots, and sediment; lay them in heaps as a preparation of manure measurably to replace and fertilize the barren sands and gravel, brought from the heights to fill up these hollows. I then opened ditches, raised their sides with sand and gravel, and on them planted large cuttings of poplars and willows. The ditching drained the soil, and the materials from the heights raised this swamp to the proper condition of meadow. The upland I enclosed with thorns on a willow ley *, and within the banks inlaid them with seeding trees and forest; divers of the former have been taken down for use, and some of the aquatic cuttings are grown to a timber measure; while the several subdivisions, meadow and upland, have been cultivated, and borne every species of grain and herbage, confessedly upon an equality with the long tillaged circumjacent fields *

By a process thus pursued, of which I have presumed to adduce this example, the numerous millions of waste acres, which yet disfigure our nation, may and will become, the seasons favouring, under your and your compatriots' encouragement, a widely extended garden, replete with every useful production congenial to our climate; and the boundary of its fields fenced with faster thriving trees, and more abundant in number than the present large tracts of forest produce, provide for generations yet to come an increase of those necessary timbers, that have given this island an intercourse with the inhabitants of every maritime clime, and an acknowledged superiority in the commercial world, which probably it would not have obtained but from the indigenous growth of these not sufficiently valued timbers. Although your extended encouragements have much increased them by multiplied plantations, yet their growth may be indefinitely enlarged by an encouragement for their acorn seed to be placed in every raised bank, or their seedlings planted in every new formed hedgerow; which most efficaciously might be enforced by Parliament as a conditional obligation on all to whom they are assigned, under the statute of a national enclosure. But as every seminary of oaks must be referable to a distant posterity, it

* A willow fence in this situation has the appearance of improbability, but it is yet improving.

becomes worthy of every present planter in the interior of his hedge-rows to have large cuttings of poplar * and willow †, and an intermixture with young trees of the resinous tribe. Those I have already known may be taken down as timber during the life of the planter, and as early as the inlays are grown, to afford shelter and shade to the herd and the flock, that occasionally feed within their enclosures.

I may just add, the fall of the autumnal leaf, with the manure of the depasturing cattle, may continue the fertility of these fields without extraneous aid; and where not readily procurable, I may farther add, that in the latter end of the autumn of 1799, I procured turves from different wastes, reserved them on a gravel walk, and thereon dibbled wheat, almost every grain of which succeeded, branched into divers stems, which severally bore a full and perfect grain. In the autumn of 1800 ‡, I repeated the trial, which at this instant is as promising as the other proved. The early spring of this year, 1801, I practised the same mode with tares, pease, oats, and barley, which severally are promising. I bring forward these experiments to show, that generally every waste may be rendered productive by the first simple operation of the plough, and thereby supercede the long process pursued by many; call forth to the earliest production the unprofitable wastes of the kingdom; and hence, as far as human foresight can discover, prevent such a sensible scarcity as most of our provinces have recently felt. And again, under the blessing of Providence, witness a competency for ourselves, and a surplus for other nations; and thence be commercially beneficial to a large portion of mankind.

* Of poplars, the *nigra*, *alba*, and *hybridum*; this latter hath not, I conceive, found its way into any systematical arrangement of plants, and in course has not received any specific character. The name assigned it is on the opinion of a gentleman well acquainted with botanic distinction, who conceives it to be a variety, perhaps of the two former. I may speak from an enlarging experience, that it is a handsome and fast growing tree, multiplies itself distinctly from its roots, while its cuttings take with nearly equal facility as the two former.

† *Pentandra*, (laurel-leaved) *amygdalina*, (almond leaf) *alba*, (common grey leaf.) These three species I know, or presume on the progress the first has already made, will severally grow to a timber bulk. The prospective diversity of contrasted foliage can perhaps be not better exemplified than in the vivid green of the laurel willow, and the hoary leaf of the white poplar.

‡ There is an average of four large ears to every grain dibbled, now in full flower, which conveys an expectation of more than a hundred fold increase, the actual increase of the preceding year. These turves or flags have received no aid from manure, or any artificial watering.

ACCOUNT OF WASTE LAND IMPROVED BY J. BUTLER, ESQ. OF BRAMSHOTT, IN HAMPSHIRE *.

In the year 1802, I purchased an estate, situate in the parish of Bramshott, in the county of Hants, of which seventy acres and upwards were then waste lands, growing a little timber, furze and alder, and supporting a few cows in the summer, but never cultivated or considered worth that expence.

From particular engagements at the time, I did not begin any improvement till 1804, when I found sixty-five acres and a half (statute) of the said waste lands in the following state: twelve acres, the site of old fish ponds, growing nothing but reeds and rubbish; eighteen acres one rood thirty-seven perches, affording a little sour grass and a few alders in wet places; twenty-seven acres three roods one perch, quite a morass or bog, with a few alders; and seven acres one rood four perches of very indifferent furze.

As the greatest part of the waste was filled with innumerable springs that deluged the whole, and caused the bog to be saturated throughout the year, I considered that draining was the first necessary step to be taken. With this view I made an open cut or ditch, of five to seven feet deep or more, in the lowest part of the bog, to let out the stagnated water, and ascertain with precision the cause that produced it. Having obtained the lowest possible fall by the open cut or ditch, I caused the other cuts to be made to the heads of different springs which fed the land, occasionally boring with the auger, that no spring might be passed over; and I then laid the open cuts or drains with stones from three to twelve feet below the surface, according to circumstances, to carry off the water, observing always to keep the level.

At the highest ground I found rocks, under which the principal springs lay, at the distance of at least fifteen feet, and thence an immensity of water gushed out, which was easily passed off through the drains, and I had the satisfaction to find, that in the course of two years the whole waste became perfectly dry, and so continued.

* Transactions of the Society of Arts, vol. XXVI. p. 117. The silver medal of the society was voted to Mr Butler.

The extent of land thus drained being great, the cost of course is very considerable, and amounts to the sum of 338l. 2s. 11d.

During this I grubbed the greatest part of the land, which, from the stems of oak and other timber that had formerly grown there, as well as the alder, furze, and some timber standing at the time I made the purchase, was no inconsiderable work, and cost for each oak stem ninepence, and for the soil on which the alders and furze grew, sixpence per rod, amounting in the whole to the sum of 95l.

The ground being now cleared, I ascertained, by the means of a water level, the position of a little brook which ran through the waste land, and found that it was practicable to turn water over thirty acres of it. This being an object of the first consequence, I spared neither pains nor expence to accomplish it. I removed the high banks round the fish ponds, which contained some thousand loads of soil; filled up very deep ditches and stew ponds, and laid several acres on an inclined plane; burnt the roots and rubbish, and prepared, by levelling and making water carriages, thirty acres for irrigation, of which sixteen acres, though rough and some pasture, as before described, had by draining and feeding began to improve considerably; and in the spring of 1806, I was enabled to turn the water over such sixteen acres, from which I derived a tolerable crop of hay in that summer. Feeding it harder afterward, and watering it the following winter, there was a good supply of feed for sheep till the latter end of April, when it was laid up and watered as before, but with far better success, as the crop was not only greatly improved in quality, but likewise in quantity, producing more than two tons to an acre throughout the sixteen acres.

The residue of the thirty acres prepared for irrigation, as before stated, formerly fish ponds and other rough lands, but lately levelled and sown with perpetual grasses, is now looking remarkably well, and will certainly be in readiness to receive the water, as soon as the land is firm enough for this purpose.

In accomplishing this work, I had the assistance of Joseph Trigger, who lived with and managed the water meadows of the late Mr Bakewell of Dishley for more than twenty years; and it would be an act of injustice to him not to say, that the said land is prepared for a water meadow in a masterly style. This cost me not less than 223l.

As soon as I perceived the effect of my drains on the bog, which was composed of a good deep peat, I pared by hand

thirteen acres of it, which I burnt, and spread the ashes; then ploughed the land once, and sowed it with cole seed in the month of July. The crop turned out very good, and fed one hundred and sixty-two shear hogs (Leicester) for two months; after which I ploughed it once only, and sowed it with white oats in the month of April 1807. At first the oats appeared sickly, but receiving a few warm showers in May, they recovered and flourished exceedingly, making a most excellent appearance, to the astonishment of the neighbourhood; for, when reaped, they were estimated at from ten to thirteen quarters per acre, some parts being preferable to others, but the whole good; and I have no doubt, for at present they are not thrashed, that the crop will amount to its estimate.

In the course of last year, I pared seven acres more of the said bog, and burnt and spread the ashes in a similar way to the former, and sowed it with cole seed from one ploughing in July last, which likewise turned out a most excellent crop, and supported seventy-two large sheep on it for more than two months.

The expence of paring and burning the twenty acres came to 29l. 10s.

The remaining waste land being a lighter peat, mixed more with sand, I did not think it advisable to pare and burn, but contented myself with fallowing it for turnips, with which it was sown last summer; but from the indifference of the season, the crop did not prove abundant, yet as much so as I had any reason to expect; and I have no doubt, by proper management of it, though by far the worst of the waste, it will shortly become very useful land, and produce in succession good turnips, barley and seeds.

On a review of the foregoing statement, it will appear that the expence attending the improvement of the waste has been great; but it will be recollected, that the quantity of land reclaimed is very considerable, the greatest part of which has been drained and grubbed, and the face of it entirely changed; that on the comparison I now submit, I feel great satisfaction in being enabled to assert, in the judgment of able men, that at the time I made the purchase, the waste land was not worth more than 5s. per acre per annum on an average, which amounts to 16l. 7s. 6d. and that it is now worth and let as follows:

Sixteen acres of water meadow, 3l. per acre	L. 48	0	0
Fourteen ditto will shortly be as valuable -	42	0	0
Twenty ditto of reclaimed bog, 2l. per acre -	40	0	0
Fifteen and a half ditto lighter peat, 1l. per acre	15	10	9
By the year - - -	L. 145	10	0

I have not pointed out minutely every step that has been taken to drain, to irrigate, or improve the said waste lands, because the subject is generally so well understood; but I trust I have stated sufficient to prove, that the soil, thus reclaimed, is turned to a great and lasting benefit.

ON THE FERTILIZING PROPERTIES OF MANURES WHICH CONTAIN AMMONIA.

BY MR WILLIAM COX*.

It is only within the last three weeks or a month that any application was made to me for my opinion on the use of any of the articles produced by Windsor's apparatus, and therefore I have not had the opportunity of making any experiments with this identical ammoniacal liquor, especially with regard to the use to which I beg leave to state I think it applicable. But it will readily be admitted by several gentlemen present, acquainted with chemistry, that ammonia is a chemical matter, as identical in one situation as in another; and as long as I am certain that it is ammonia, it is the same thing if it is produced here or in the North. I was desirous, some years ago, of making ammonia in large quantities, and was of course at some pains in ascertaining what would be the most economical process for its production: I had resort to the various different articles of a refuse nature, such as were easily to be procured at the cheapest rate, for the purpose of obtaining ammonia; but I found, however much I varied the article, that, according to the quantity of ammonia I could produce from that article, the farmers had always been beforehand with me in raising the price of it; as they found it useful in the same proportion in its application on land: and that is as far as I am acquainted with the matter. Of

* From Minutes of Evidence taken before the Committee of the House of Commons on the Gas-Light and Coke Company's Bill.

course the production of ammonia, on a great scale, would be of great importance to the agricultural interest.

Are you acquainted with the subject of the use of ammoniacal liquor, in agriculture?—I am.

[The witness here read a paper to the committee.]

Gentlemen,

Your inquiry as to my opinion of the uses to which your ammoniacal liquor is or may be applicable, I shall endeavour to satisfy as far as the shortness of time will permit. Positive evidence of the immediate result of experiments, which require time and seasons, cannot be obtained in regard to such uses as, from the closest analogy and the most reasonable inference, we should be induced to apply this production of your process to. There are many uses in the arts and manufactures to which the application of the ammonia or volatile alkali is well known, and which are already in part enumerated. But when the demand for these purposes is supplied, and, on the probable great extent of the production of your ammonia, should a surplus quantity remain, I have reason to think, that in some very considerable departments of agriculture that surplus, however great, will find a ready and adequate market. A judicious application of ammonia to land before it be sown with turnips, (but if afterwards, on no account after the plants are up), is likely to produce the most beneficial results. What justifies me in this conclusion, is the simple consideration, that all the powerful and concentrated manures of high price, and in great request, are just so in the degree in which I have found them by analysis to contain either ammonia or the elements that compose it. Soot, well known to be in small quantities a powerful encourager of vegetation, contains much carbonate of ammonia, combined with some of the carbonaceous parts, rendering them extractive and soluble in water, forming a brown pungent liquid. Pigeon dung is a dressing for turnip land in great request in the North, where many hundred quarters are annually sold at 12*l*s. the quarter, though a very small proportion of the demand is supplied. I have found, by experiment, that this material is richly impregnated with carbonate of ammonia as well as with the well-known element of ammonia, azote, which, in the natural decomposition of the manure by putrefaction, when committed to the earth, will be produced. Rape dust is that particular part of the seed (left after the oil is pressed out) which is intended by nature to corrupt, and become the early cause or stimulus of the growth of the embryo germ, and therefore contains the same element, and which

we can readily, by a chemical process, exhibit in the ammonia which rape dust may be made to yield. It is hardly necessary to mention urine, &c., from which ammonia is obtained in great quantity, or the dung of all animals, which contains the same principle. It was from the dung of the animals which fed on the fertile plains of Egypt that all the sal-ammoniac known in commerce was for many centuries obtained. From that country, the site of the temple of Jupiter Ammon, its name is derived. Soon after sal-ammoniac became an article of European manufacture, it was discovered that the bones and horns of animals yielded its peculiar salt, that is to say, the ammoniacal principle, in much greater quantity than their dung, and those parts were alone used to the exclusion of these: hence the name spirit of hartshorn, given to the volatile alkali used in medicine. It has been of late years discovered, that the scrapings, shavings, and chips of the horns used in manufactures (particularly of the knife handles at Sheffield) are the most powerful and the best of all land dressings known; and it is from these very materials also that the greatest quantity of ammonia is to be obtained, wool, silk, and hair excepted, and these are again in great use in agriculture, when collected and sold as old woollen rags. Bones of all kinds, not excepting human bones, are sent by sea in great quantity from this metropolis into the north: many hundred tons of these are ground, or rather broken small, in mills contrived on purpose, as the quantity necessary for an acre of land is small in comparison of other materials. The convenience of easy carriage is the cause of the most distant lands being brought into the richest cultivation. It would not be proper, on this occasion, to enter into a theoretical disquisition on the nourishment of vegetables, whether they derive their food wholly, or only in small part, from the earth by their roots, or from the atmosphere by their leaves and green parts; but it appears clear to me, that that principle which the farmers term warmth and force, is constantly accompanied by the chemic element mentioned. This stimulus of encouragement and force is of more consequence to the growth and eventual vigour of annuals than of perennials, and particularly at the early periods immediately succeeding the expenditure of this sure principle which nature has provided in the seed. The putrefactive fermentation always generates ammonia; the earth imbibes the different miasmata, and holds them in store for the use of plants; to these they impart health, strength, and, as may be said, appetite.

A great difference is observed by farmers in the qualities of the manure of cattle, when fed on oil cake or on hay; it is supposed to be of four times the value in the first case. The beneficial effects of sometimes mixing lime with arable soil is easily explained in this way. The ammonia is always to be recognised by its peculiar smell. As soon as newly slacked lime is mixed up with the mould of a good soil, but which is beginning to show signs of impoverishment, in this case, the ammonia, which had formed a chemic combination with the fixed acids of the manure (formerly ploughed in and fermented) is set at liberty. These are the phosphoric and vitriolic acids, which, as is well known, will leave ammonia to combine with lime. I have therefore no hesitation in declaring, as matter of opinion, that the production of ammonia, in great quantity, and its judicious application to agricultural purposes, are processes of great importance to the landed interest.

ON THE ADVANTAGES OF THE USE OF OXEN AND NEAT CATTLE IN HUSBANDRY.

BY LORD SOMERVILLE*.

You will have the goodness to express to the Bath Society my regret, that I cannot attend its anniversary meeting, as was my intention.

On the subject of my claim to the premium for a change of sheep stock, &c., I have only to observe, that it was made at a period the most unfavourable to stock, when distress for keep of all sorts was greater than I have ever known; and that whether the premium be adjudged or not to me, I shall ever consider the favourable reception it met from the committee to which it was referred, the able essays which it produced, and the recommendation which this committee, numerously attended, has unanimously given to this general meeting that it should be awarded, together with the proofs since produced, as decisive on this most important question.

The return of my year's labour with oxen was made out for the year 1803, because the year 1804 not beiug expired,

* Bath Society's papers, vol. x. p. 56.

to have made it without the amendment, since resolved on, would have been a palpable error. I now comply with the repeated and earnest wishes of the society, in presenting this statement for its inspection.

Unprepared as I was, it would have been impossible to have done it with that degree of accuracy, which I shall adhere to in any statement of serious import to the public; but the rules which govern the proceedings of the Bath Society allowing me time to examine my own books, and to obtain replies to certain needful questions, I have great pleasure in stating, that the following report is now presented to the society, in substance, I trust correct. In that part of the statement, which reduces the hauling and carting of manure to be equal to a given number of acres ploughed, I have profited by the kind assistance of Mr Paul, and Mr Gordon Grey.

No land ploughed with horses, save part of one acre, as a trial.

	No. of acres
Forty-four acres of ley ground broke up -	44
Fifty ditto of spring corn, two earths, scarified and dragged, equal to 1½ earth more	170
Sixty ditto of turnips, at three earths, cultivated, or scarified and dragged, equal to 1½ earth - - - - - - -	271
Twenty-two ditto pease, at one earth, and broad-cast dragged, part of it drilled -	26
Fifty-seven acres of wheat, 32 acres on one earth, once dragged, and twenty-five of heavier land, twice ploughed and twice dragged - - - - - - -	123
Twenty-nine ditto of ley ground, broke up to December 1st - - - - -	29
Three ditto of beans, seven ditto winter vetches, two ditto potatoes, cultivating, dragging, &c. - - - - - -	17
Lime carried and "butted"* over the land, 160 butts, equal to two acres work, being a large proportion of 1920 hhds. or 9600 bushels of lime - - -	120 Hauling 125 Butting*
Carried forwards	925

* Butting. The lime being mixed with the forehead or head-lands, round the edges of the field, is thence carried in implements called butts, bodily over the land—a laborious but good management.

Brought forward	925
Twenty-five acres of the turnip land dunged, equal to 30½ - - - - - -	30½
Total	955½

Hay-harvest, corn-harvest, corn to market, hauling of timber, &c. not easily calculated, but still to be allowed for, probably amounting to [omitted]

Allowing for the three-year-old steers ninety acres, and eight half-days work of two two-year-old bulls, worked occasionally with the steers for the purpose of keeping them quiet; allowing also as above the hay-harvest, &c. not brought to account; it will appear, that the labour of the twelve oxen throughout the year will amount to, if not exceed one thousand acres.

The average amount of our labour is two acres of ley ground per day, and fallowing and stirring more than two acres; but the second cross ploughing, or earth, somewhat less. Our teams consist of four oxen, a man, and a boy, to each double furrow plough, and to each four-wheel waggon. Our ploughing in general very deep, and our fields small, not exceeding 4 acres each on the average. These two circumstances are to be duly considered as adding materially to the labour. The working stock consists of sixteen steers and oxen two bulls, and three light horses, *viz.* six five-year-old oxen, six four-year-old steers, and four three-year-old ditto. They are fresh growing stock, and are regularly turned out to graze after the barley-sowing, at six years old. The whole object aimed at is to carry on our course of crops on the most speedy and vigorous system, but without injury to the growth of the stock.

It is evident, that my labour, severe as it long has been, cannot be found to injure the health or growth of the stock; the exhibition of my oxen annually, within ten months grazing from the time they are turned out of work, will fully exemplify this important fact. This was in great part my object in establishing the *Barbican* cattle-shew; and if I may be allowed to say so, the effect already produced, more especially in countries where oxen were held in disrepute as animals of labour, has exceeded my most sanguine expectations. That our crops are worked in so expeditiously as to amaze those who contend for horse labour only, cannot be denied; in proof of which, fifty seven acres of wheat were this autumn plowed, sown, and manured in a complete manner, according to the usage of the country, within three weeks, although the weath-

er was unfavourable, and the land worked close and heavy. The last nine acres were ploughed, sown, dragged, and harrowed, in one day. In obedience to the wishes of the society I present them with this statement; but I wave all claim to a premium. If, however, in the ordinary course of business, any man in this kingdom shall be found to have done more at a less cost, I shall consider myself as having trespassed unworthily on the notice of this society. It is fitting to add, that in twenty years labour I have not lost one ox or steer, or or ever broke a yoke or pair, by sickness, death, or accident. And I may farther add, that, so far from incurring any loss of value from working cattle after their full growth, as is supposed to be the case with horses, amounting to 25 per cent or more; my own experience, and the concurring opinion of the committee sent to examine our stock in the month of June last, warrant me in declaring, that working-cattle, from three to six years of age, do actually gain at the rate of 26 per cent yearly; the loss in my own case, in twenty years, being nothing!

The premium now in question, having distinctly waved my claim to it, will probably be awarded to Mr Billingsley; and it gives me sincere pleasure, that it should be bestowed on him. He has been a most strenuous and successful advocate for the labour of oxen, and is well aware of its extreme importance. Mr Billingsley has accomplished a measure hitherto untried, namely, to set out his ploughing by the acre, and to apply one team of oxen, full grown, with two to assist, in all eight oxen, to constant plough-labour, every day in the year that it was possible for them to work. I consider the attempt of such consequence to the landed interest, so momentous an illustration of the powers of these superior animals in labour, that I beg leave here to offer him my sincere thanks; and I have the honour to be,

With all respect to the Society, &c.

SOMERVILLE.

PRACTICAL STATEMENT ON THE FOREGOING SUBJECT, WITH CLAIM OF PREMIUM.

BY JOHN BILLINGSLEY, ESQ.*

The claimant states, that his servant Esau Green has on a farm of eight hundred acres, the soil of which is of a middling texture, ploughed and harrowed, with a team of six oxen and a double-furrow plough, the following acres of land, *statute-measure*, between the 1st day of January and the 1st of December, 1804, *viz.*

Acres.
56 of oat stubble.
62 of turnips for oats.
68 of ley.
68 of ley cross-ploughed for a fallow.
100 of fallow, for the purpose of being cleaned after a slovenly tenant.
19 of vetches.
12 of vetches folded off, and sown with wheat.

385 acres ploughed in eleven months.

56 of oat stubble.
62 of turnip sown to oats.
14 of ley.
80 of fallow.
48 of cross-ploughed ley.
19 of vetches.
12 of wheat.

291 acres harrowed in the same eleven months.

The claimant farther states, that no possible error can have crept into this statement. No other team being employed in the tillage of this farm, and the ploughman being paid by *the acre*. Nor can any doubt arise respecting the size of the acres, as it is well known, that lands newly enclosed are set out *statute-measure*.

* Bath Society's papers, vol. x. p. 61.

The oxen employed were home-bred, of the long-horned race, and were purchased last year of one of the claimant's tenants, at the price of 14*l.* each. Four of them were six years old, and four of them four years old.

Though eight oxen were kept, six only were worked at a time. The other two were changed as occasion required, at the will of the ploughman. These oxen are in no respect injured by their labour, and are now in good working order.

The ploughman and driver were paid 1*s.* 4*d.* per acre for ploughing, and 6*d.* per acre for harrowing; and in this was included all necessary attendance on cattle at all times and seasons.

The depth of ploughing from 3 to 5 inches.
The breadth of ditto from 7 to 10 inches.

As the harrowing was all performed with six oxen, drawing very heavy and long tined harrows, (provincially called drags) and in many fields two bouts in a place, it will not be unfair to estimate *two* harrowings as equal to *one* ploughing; and in proof of this comparison it may be observed, that the double plough will turn two acres and a half in eight hours, which are half as much as six oxen can harrow in the same time.

Presuming that no solid objection can be brought to the foregoing statement, it may be satisfactory to the Society to see the debtor and creditor sides of the account, methodically arranged, so as to ascertain the cost both of the ploughing and harrowing per acre, *statute-measure*.

DR.

Eight Working Oxen, from Jan. 1st to Dec. 1st, 1804.

To 24 lb. of hay per week, consumed between Jan. 1, and May 12, when they were turned to grass, at 2*l.* 10*s.* - - - - - - L.	47	10	0
To 24 weeks keep at grass, at 3s. each ox -	28	16	0
To 6 tons of hay, between Oct. 1, and Dec. 1, when at grass - - - - -	15	0	0
To repair of yokes and bows - - -	0	18	0
To wear of plough and dressing shares, mending chains, &c. - - - - -	4	13	6
To cash paid Esau Green for ploughing 385 acres in eleven months, at 1s. 4d. - - -	25	13	
To cash for harrowing 291 acres, at 6d. - -	7	5	6
L.	129	16	4

N. B. This price per acre includes driver and attendance.

		Cr.		
By 385 acres ploughed, at 4s. 10½d.	- -	93	8	10
By 291 acres harrowed, at 2s. 6d.	- -	36	7	6
	L.	129	16	4

If this had been let by hire, it would nct have been taken by any neighbouring farmer at less than 8s. per acre ploughing, and 4s. per acre harrowing.

If the harrowing of *two* acres be admitted as equal to ploughing *one*, it follows, that the work done by these oxen, (caparisoned in the old fashioned way with yokes and bows) is equal to the ploughing of 530 acres in eleven months, or 578 acres in a year.

It may naturally be supposed, that on so elevated and exposed a hill as that of Mendip many interruptions to tillage work must occur in the course of a year, notwithstanding which the man's earnings (driver included) amount to 14s. per week nearly; to which must be added sundry work in the time of harvest, (after his days work at ploughing) and other occasional labour, amounting to the average of 2s. per week, constituting altogether the receipt of 13s. per week for himself, and 3s. per week for his boy.

In conducting this experiment the claimant has sedulously guarded his mind against all bias and partiality, being desirous of getting at the truth by the most accurate investigation; and he has no doubt, that the statement of work performed under the direction of a noble lord (the rival candidate for this premium) will lead to the same conclusions, and rescue this most useful animal from that degraded state of inferiority, in which he has unjustly been classed.

At Midsummer last the claimant had not the most distant idea of starting as a candidate; and since that time he has in no way whatever stimulated the ploughman to *extraordinary* exertion.

In letting his tillage labour by contract he has not departed from the uniform practice of twenty-five years. A practice originating from an idea, that the best method of making servants laborious and honest is to make it their interest to be so.

Encouraging however as these facts must be to the use of oxen in this department of husbandry, he does not venture to say, that they will answer in all countries, or on all soils.

On all light sandy soils, such as Norfolk, Suffolk, &c. single ploughs of different constructions, drawn by two horses without a driver, may in cheapness of execution nearly ap-

proach the double-furrow drawn by four oxen. But on all level soils unincumbered with stones, and where good pasture may be found for summer, and good hay for winter keeping, oxen with the double-plough may in his opinion be considered as justly entitled to a preference.

JOHN BILLINGSLEY.

AN ACCOUNT OF THE CHINESE METHOD OF PROPAGATING FRUIT TREES BY ABSCISSION.

BY DR JAMES HOWISON *.

The Chinese, in place of raising fruit trees from seeds or from grafts, as is the custom in Europe, have adopted the following method of increasing them.

They select a tree of that species which they wish to propagate, and fix upon such a branch as will least hurt or disfigure the tree by its removal.

Round this branch, and as near as they can conveniently to its junction with the trunk, they wind a rope, made of straw, besmeared with cow dung, until a ball is formed, five or six times the diameter of the branch. This is intended as a bed into which the young roots may shoot. Having performed this part of the operation, they immediately under the ball divide the bark down to the wood, for nearly two thirds of the circumference of the branch. A cocoa-nut shell or small pot is then hung over the ball, with a hole in its bottom, so small that water put therein will only fall in drops; by this the rope is constantly kept moist, a circumstance necessary to the easy admission of the young roots, and to the supply of nourishment to the branch from this new channel.

During three succeeding weeks, nothing farther is required, except supplying the vessels with water. At the expiration of that period one third of the remaining bark is cut, and the former incision is carried considerably deeper into the wood, as by this time it is expected that some roots have struck into the rope, and are giving their assistance in support of the branch.

* Trans. of the Soc. of Arts, vol. xxv, p. 14.

After a similar period the same operation is repeated, and in about two months from the commencement of the process, the roots may generally be seen intersecting each other on the surface of the ball, which is a sign, that they are sufficiently advanced to admit of the separation of the branch from the tree. This is best done by sawing it off at the incision, care being taken that the rope, which by this time is nearly rotten, is not shaken off by the motion. The branch is then planted as a young tree.

It appears probable, that, to succeed with this operation in Europe, a longer period would be necessary, vegetation being much slower in Europe than in India, the chief field of my experiments. I am, however, of opinion, from some trials which I have lately made on cherry trees, that an additional month would be adequate to make up for the deficiency of climate.

The advantages to be derived from this method are, that a further growth of three or four years is sufficient, when the branches are of any considerable size, to bring them to their full bearing state; whereas, even in India, eight or ten years are necessary with most kinds of fruit trees, if raised from the seed.

When at Prince of Wales' Island, I had an opportunity of seeing this proved by experiment. Some orange trees had been raised by a gentleman, from seeds sown in 1786, which had not borne fruit in 1795, while branches taken off by the Chinese mode in 1791, had produced two plentiful crops.

Whether forest trees might be propagated in Europe in the same manner, I have not had experience sufficient to form a judgement: if it should be found practicable, the advantages from it would be great, as the infancy of trees would, by this means, be done away, a period which, from the slowness of their growth, and the accidents to which they are liable, is the most discouraging to planters.

The adoption of this method will, at all events, be of great use in multiplying such plants as are natives of warmer climates, the seeds of which do not arrive here at sufficient maturity, to render them prolific.

I have frequently remarked, that such branches of fruit trees, as were under the operation of abscission during the time of bearing, were more laden with fruit than any other part of the tree. It appeared to me probable, that this arose from a plethora, or fulness, occasioned by the communication between the trunk and branches through the descending vessels being cut off by the division of the bark, while that by the ligneous

circles or ascending vessels, being deeper seated, remains*. The same reasoning accounts for fruit trees producing a greater crop than usual, on being stripped of their leaves, most of the ascending juices being thrown off by them in perspiration, or expended in their nourishment, for we find that bleeding trees cease to give out their juices after they have put forth their leaves †.

I have observed, that the roots from a branch under the operation of abscission were uniformly much longer in shooting into the rope when the tree was in leaf, than the contrary; hence, the spring season appears most proper for performing this operation.

It will seem singular, that the Chinese entertain the same opinion that Linnaeus did, respecting the pith of trees being essential to the formation of the seed. By cutting into the trunk of the guava tree before it has produced, and making a division in the pith, they have obtained fruit without seed.

Reference to the Engraving, Plate VI. Fig. 1, *of the Chinese Method of propagating Fruit Trees by Abscission.*

A. The tree on which the operation is performed.

B. The straw rope wound in a ball round a branch of the tree.

C. The cocoa-nut shell, or vessel, containing the water, which gradually drops thence on the ball below it.

D. Another branch of the same tree, from which the part E, rooted in the straw rope or ball, and now ready for planting out, has been separated.

F. The vessel suspended from a branch above, and from which the ball has been supplied with water.

* The circumstances attending the Chinese method of propagating fruit trees appear a strong confirmation of Mr Bonnet's opinion, that plants, as well as animals, have a regular circulation of their fluids.

† Marsden, in his history of Sumatra, page 119, says, "the natives, when they would force a tree that is backward to produce fruit, strip it of its leaves, by which means the nutritive juices are reserved for that important use, and the blossoms soon show themselves in abundance."

ON THE CULTIVATION OF THE COMMON FLAX, LINUM USITATISSIMUM, OF LINNE, AS AN ORNAMENTAL PLANT IN THE FLOWER GARDEN.

BY MR JOHN DUNBAR *.

The Horticultural Society will perhaps honour with their attention a short paper, the object of which is to bring into cultivation the common flax, as an ornament of the flower garden, not merely as such, but with a view to the profit it will afford, at least to the servant, if not to the master; and the interest of the former can seldom be promoted in an honest way, without some benefit accruing to the latter. This plant, when so cultivated, like wax and honey, forms part of the natural riches of a country, and if it could supplant the cumbersome yellow lupine in our flower borders, the annual revenue arising from it would amount to several thousand pounds.

If gardening were in its infant state among us, a complete treatise on the culture of this plant might be necessary; but as this is not the case, only what is especially material will be noticed, with some directions how to prepare the plant after it is gathered. They are the result of several years experience, by which a family consisting of five persons has been supplied with all the linen they required.

The soil of every flower garden is always rich enough to produce good flax; but if it is loamy rather than sandy, the quantity will be nearly double: even in the fields, which can never be cultivated with the nicety of a gentleman's garden, I have observed the greatest crops in a loamy soil, and that they yielded an article superior in quality as well as quantity: for as the durability of the fibre depends in some measure upon its size, there can be no doubt that tall and vigorous plants are preferable to small ones.

There are various ways of disposing this plant so as to be exceedingly ornamental, but none more so than scattering it in random parcels, or little clumps of from ten to twenty plants, towards the back of the flower borders, and in the front

* Transactions of the Horticultural Society, p. 71.

of the shrubbery: for, without the summer proves uncommonly dry, it will attain to the height of three or four feet. If a temporary edging, or summer screen, is wanting for any particular bed, it may be also employed for this purpose.

The seeds of good flax are short, plump, thick, very oily, and of a bright brown colour. The best season for sowing them, in most gardens, is February, or the beginning of March, when the general crop of hardy annuals are put in; but if the ground be sandy, and naturally dry, they should be sown in October or November. No more attention than what is necessary for the other flowers in the garden, which is keeping down all weeds while in the seed leaf with a hoe, will be requisite for this. As soon as the seed begins to ripen, and the plants turn yellow, pull the whole up by the roots, and lay it in bundles exposed to the full sun, if the weather is fine, to dry completely. Then pull the heads off, and shake out the seeds. Immediately after, it must be laid to macerate in a ditch, or pond of water, and kept under by a long piece of timber floating upon it. From five to ten days is the time necessary for its immersion, and after the fifth, it must be examined daily, taking especial care that it does not lie too long. As soon as ever you find the fibres are sufficiently macerated to separate from one another kindly, spread it out to dry upon a new mown meadow. When dry, it must be again collected into bundles, and either sent to the flax dresser, or prepared for spinning at home by the gardener's wife. In many districts, this operation is well understood, and if carefully performed, homespun linen from such flax will last twice the time of most of the Irish linen that is now to be purchased in our shops.

I believe it is a great error to pull the flax so green as is commonly practised, and a still greater to soak it in water before it is previously dried; for the fibres require twice the time to macerate sufficiently for separation in the dressing; a process by which they are considerably weakened.

AN ACCOUNT OF THE METHOD OF CULTIVATING THE AMERICAN CRANBERRY, VACCINIUM MACROCARPUM, AT SPRING GROVE.

BY THE RIGHT HON. SIR JOSEPH BANKS, BART. K. B. P. R. S. &c.*

The American cranberry, the Vaccinium macrocarpum, has for some years been cultivated with success at Spring Grove, and as the fruit of it is now become an object of some importance in the economy of the family, a short account of the management of this unimproved plant will, it is to be hoped, prove acceptable to the members of this useful society, and not uninteresting to the public at large.

For the better understanding the intended communication, it is necessary to premise, that a spring rises in a small grove within the precincts of Spring Grove, which is no doubt the origin of the name; this spring is carried in leaden pipes into the house, to which it affords an ample supply; the waste water is suffered to run through a small basin and a pond in the pleasure ground, before it escapes to Smallberry Green; to this constant supply of fresh water, though it is very small, the great luxuriancy with which water plants of all kinds suitable to this climate succeed in the pond, is no doubt in some degree to be attributed.

In the middle of the basin, a small island has been formed, by supporting a box of oak upon posts driven into the bottom; in the centre of this pond, the waste water, which used before to issue through a fountain, is suffered to flow in the form of a spring, which rises into a large shell of the Chama gigas, perforated for the purpose, imitates very well a natural spring, and gives in hot weather an appearance of freshness and coolness, very pleasant to those who walk in the garden.

The oak box, which constitutes this artificial island, is circular, 22 feet in diameter, and 13 inches deep; the bottom is five inches under the surface of the water, and bored through with many holes; on this a layer of stones and rubbish was

* Transactions of the Horticultural Society, vol. I, p. 75.

first placed, and upon that a covering of bog earth, brought from Hounslow Heath, which together are five inches below and seven inches above the surface of the water of the bason; in this bed of black mould, a variety of curious bog plants were placed about seven years ago, which flourished in an unusual degree; among these was the Vaccinium, which flowered and ripened its fruit the first year.

In the autumn of the second year, it again produced a plentiful crop, and soon after began to send out runners somewhat resembling those of a strawberry, but longer, and rather less inclined to take root while young; they did, however, take root in the winter, and early in the spring threw out upright branches ten inches and a foot long, on which the flowers and fruit were chiefly placed; the produce was this year gathered, and found to be high flavoured berries, very superior to those imported, which have in general been gathered unripe, and have become vapid and almost tasteless by long soaking in the water, in which they are packed for carriage.

It was now determined to consider the American cranberry as an article of kitchen garden culture, and to give up the whole of the island to it, which in a few years it entirely covered by its own runners, without any fresh plants being put in; and this bed, with the addition of some hanging boxes receding from the centre to the sides, produced, in the year 1806, twenty-three bottles of very fine cranberries.

In the year 1805, a bed was made on the side of the pond, 20 feet long and $5\frac{1}{2}$ feet broad, by a few stakes driven into the bottom parallel to the side, and lined with old boards; the bottom of this was filled up with stones and rubbish, and on these a bed of black mould, three inches above and seven inches below the usual surface of the water, was laid: this was planted with cranberry plants, many of them having been rooted in a hot bed, in which they throve most vigorously. In this autumn, 1807, the bed produced a crop which, added to that of the island, afforded a supply for the family of five dozen bottles of cranberries, beside a small basket reserved for present use. The total contents of the two cranberry beds is 326 square feet; the quantity of land employed for raising strawberries at Spring Grove is, after the divisions between the beds have been deducted, 5645 square feet; the beds necessary to give a sufficient supply of cranberries for the family did not therefore occupy quite one sixth of the space allotted to strawberries.

The society will, I hope, forgive this detail of the origin and progress of this kind of cultivation: successful as it has

been, it must still be considered in its infancy, and not sufficiently established to afford general rules for the regulation of a gardener's proceedings; it originated entirely in a fortunate accident, the history of which will, it is hoped, give an adequate idea of the method now practised, and at the same time bear testimony in favour of the opinion, that more benefit has been derived in the advancement of horticultural knowledge, by pursuing the hints which nature continually gives, than from the effects of abstract reasoning and original invention.

It is remarkable, that, during the seven years these cranberries have been cultivated at Spring Grove, no circumstance has arisen, from the variety of seasons, from blight, or any other circumstance, that has diminished the quantity of a full crop; the flowers have issued out of their buds, in abundance, in their due season, and fewer of them have been abortive, than in general is the case in other plants. The fruit has gradually swelled and duly ripened without being subject to the attack of any vermin, or to injuries of any kind, from the excesses of heat or cold, or from those of wetness or of drought.

METHOD OF PRESERVING FRUIT WITHOUT SUGAR, FOR HOUSE USE OR SEA STORES.

BY MR THOMAS SADDINGTON *.

The bottles I chiefly use for small fruit, such as gooseberries, currants, cherries and raspberries, are selected from the widest-necked of those used for wine or porter, as they are procured at a much cheaper rate than what are generally called gooseberry bottles. Having got them properly cleaned, and the fruit ready picked, (which should not be too ripe), fill such of them as you intend doing at one time, as full as they will hold, so as to admit the cork going in, frequently shaking the fruit down whilst filling. When done, fit the corks to each bottle, and stick them lightly in, so as to be easily taken out when the fruit is sufficiently scalded, which

* From Transactions of the Society for the Encouragement of Arts, Manufactures and Commerce, for 1807.——Five guineas were voted by the Society to Mr Saddington for this communication.

may be done either in a copper, or large kettle, or saucepan, over the fire, first putting a coarse cloth of any sort at the bottom to prevent the heat of the fire from cracking the bottles: then fill the copper, or kettle, with cold water, sufficiently high for the bottles to be nearly up to the top in it: put them in side-ways, to expel the air contained in the cavity under the bottom of the bottle; then light the fire if the copper is used, taking care that the bottles do not touch the bottom or sides, which will endanger their bursting; and increase the heat gradually until it comes to about one hundred and sixty or one hundred and seventy degrees, by a brewing thermometer *, which generally requires about three quarters of an hour. For want of such an instrument, it may be very well managed by judging of the degree of heat by the finger, which may be known by the water feeling very hot, but not so as to scald it. If the water should be too hot, a little cold may be added to keep it of a proper temperature, or the fire may be slackened. When it arrives at a sufficient degree of heat, it must be kept at the same for about half an hour longer, which will at all times be quite enough, as a longer time, or greater heat, will crack the fruit. During the time the bottles are increasing in heat, a tea-kettle full of water must be got ready to boil as soon as the fruit is sufficiently done. If one fire only is used, the kettle containing the bottles must be removed half off the fire, when it is at the full heat required, to make room for boiling the water in the tea-kettle. As soon as the fruit is properly scalded, and the water boiling, take the bottles out of the water, one at a time, and fill them within an inch of the cork with the boiling water out of the tea-kettle. Cork them down immediately, doing it gently, but very tight, by squeezing the cork in; but you must not shake them by driving the cork, as that will endanger the bursting of the bottles with the hot water: when they are corked, lay them down on their side, as by that means the cork keeps swelled, and prevents the air escaping out: let them lye until cold, when they may be removed to any convenient place of keeping, always observing to let them lie on their side until wanted for use. During the first month or two, after they are bottled, it will be necessary to turn the bottles a little round, one or twice in a week, to prevent the fermentation that will arise on some fruits from forming into a crust, by which proper attention the fruit will be kept moist with the water, and no mould will

* Fahrenheit's.

ever take place. It will also be proper to turn the bottles a little round once or twice in a month afterwards.

Having laid down the mothod of preserving fruit without sugar, in as clear and concise a manner as possible, I will recapitulate the whole in a few words, which may be easily remembered by any person. Fill the bottles quite full with fruit. Put the corks in loosely. Set them in a copper, or kettle of water. Increase the heat to scalding for about three quarters of an hour; when of a proper degree, keep at the same half an hour longer. Fill up with boiling water. Cork down tight. Lay them on their side until wanted for use.

It may be said, as an additional reason as well as cheapness, for using wine or porter bottles instead of gooseberry, is the difficulty of obtaining them, even at any price, in some parts of the country; and indeed they are equally useful for small fruit, and answer the purpose quite as well, excepting the little inconvenience of getting the fruit out when wanted for use, which may be easily done by first pouring all the liquor out into a bason, or any other vessel, and then with a bit of bent wire, or small iron meat skewer, the fruit may be raked out. Some of the liquor first poured off, serves to put into the pies, tarts or puddings, instead of water, as it is strongly impregnated with the virtues of the fruit, and the remainder may be boiled up with a little sugar, which makes a very rich and agreeable syrup.

In confirmation of the foregoing assertions, I now produce twenty-four bottles as samples, containing twelve different sorts of fruit, viz. apricots, rhubarb, gooseberries, currants, raspberries, cherries, plums, Orleans plums, egg plums, damsons, Siberian crabs*, and green-gages—which have all been preserved in the manner above described.

In order to diversify the degree of heat and time of continuance over the fire, I have done some in one hundred and ninety degrees, and continued them in it for three quarters of an hour, from which experiment it is evident that the heat is too powerful, and the time too long, as the fruit by that degree and continuance is rendered nearly to a pulp†. In the summer of 1807, I preserved ninety-five bottles of fruit, the expence of which (exclusive of bottles and corks) was 1l. 9s. 5½d.; but having some fruit left, it will not be right to judge them at a higher rate than 1l. 9s.; and allowing 5s. for the extra coals consumed in consequence of my not having a con-

* Apples and pears may be done for shipping, &c.

† Some of these samples of 1807, were done in 180 and 190 degrees.

veniency of doing more than seven or eight at a time, and this being done at fourteen different times, it will amount to 1l. 14s. the average cost of which is nearly 4½d. per bottle, exclusive of the trouble attending them; but if we estimate their value in the winter season at 1s. per bottle, that being in general as low or lower than the market price, they will produce 4l. 15s. but losing one bottle by accident, reduces it to 4l. 14s. leaving a net profit of 3l. on ninety-four bottles, being a clear gain of nearly two hundred per cent. Another great advantage resulting from this statement will appear by making it an article of store for shipping or exportation; and I shall submit a few ideas tending to promote such a beneficial object by doing it in large quantities; for which purpose sufficiently extensive premises must be fitted up, with a proper number of shelves, one above another, at a distance of about five inches.

The vessel for scalding the fruit in, should be a long wooden trough of six, eight, or ten feet in length, two or three in breadth, and one in depth, fitted with laths across to keep the bottles upright, and from falling against one another; this trough of water to have the heat communicated to it by steam, through a pipe from a closed boiler at a little distance. The boiling water wanted to fill the bottles with, may be conveyed through a pipe and cock over the trough, by which arrangement, many hundreds of bottles might be done in a short time. It may be prudent to observe, that this idea is only speculative, not having been actually practised, but at the same time seems to carry with it a great probability of success, and worthy the experiment.

It remains now that I state some reason or object for troubling the Society, whom I have taken the liberty to address, with these communications. The first is a desire of publicity, sanctioned by their investigation of the experiments made for preserving fruit without sugar, thereby lessening the expence attending an object of so much public benefit and utility. The second arises from a personal or private consideration; but on this subject I shall only observe, that I wish to throw myself entirely on that protection which has ever characterised the liberality of the society; and that I shall feel highly honoured if they conceive what I have communicated deserving any mark of their favour.

REPORT OF A COMMITTEE APPOINTED BY THE BATH AND WEST OF ENGLAND SOCIETY, TO INVESTIGATE THE CLAIM OF THE RIGHT HON. LORD SOMERVILLE TO A PREMIUM "FOR THE GREATEST NUMBER AND MOST PROFITABLE SORT OF SHEEP" *.

Your committee report, that the claim is founded upon facts, as under:

About the year 1800, Lord Somerville's stock (as stated by him in his memorial to the society) consisted of forty-five ewes of the long-wooled sort. Finding these annually degenerating, and also becoming annually less profitable, he changed them at the above-mentioned period for one hundred and fifty Ryeland ewes.

In the first year, though the winter was severe, the ewes supported themselves tolerably well, and the lambs were in very good order at weaning time. In their future growth, as weather and store ewes, they far exceeded in weight their parent stock. One lot of the weathers sold as high as 3l. each, and were fed upon grass and hay only.

In the following year, Lord Somerville brought from Spain some rams and ewes of the Merino breed. These rams, in each subsequent year, have been, and now continue to be, put to ewes of the South-Down and Ryeland breed; from each of which crosses a valuable species of sheep has been obtained, both in fleece and carcase; the relative value of which has been detailed by his Lordship in his memorial of 1802, the substance of which is, that

South-Down store-ewes at 3lb. per fleece, and at 1s. 10d. per lb., will pay 5s. 6d. per fleece; which, at 6½d. per acre in good upland pasture for seven months, and five months in turnips at 14 or 15 per acre, will pay 38s. or 40s. per acre.

* Bath Society's Papers, vol. X, p. 71.

Ryeland store-ewes 2¼lb. per fleece, at 2s. 2d. per lb. untrinded, nine sheep per acre, and turnips as above, will pay 2l. 3s. 10½d. per acre.

South-Down and Merino ewes of the half-breed, at 4lb. per fleece clean washed, and 3s. per lb., will amount to 12s. per fleece; which, at 7½d. per acre for seven months, amount to 4l. 10s. per acre for the pasture land, with turnips as above for winter keep.

Ryeland and Merino ewes of the half blood, at 10 per acre for seven months, and turnips as above, at 3¼lb. per fleece, and at 3s. 2d. per lb., amount to 6l. 10s. 5d. per acre.

The pure Merino fleeces never sold at less than one guinea each; the average weight of which has been more than 6lb. each in the yolk; and on the above allowance of pasture for seven months, and turnips as above in aid of that pasture, the return will amount to ten guineas per acre.

The size of the farm in Lord Somerville's occupation is four hundred and sixty acres, eighty-five of which are a dairy unfit for sheep, except for a few couples in the spring. These sheep have been depastured as under:

56 Acres one and two years old clovers, indifferent keep, some worn-out ley.
85 Acres marsh and capital pasture.
35 ditto upland summer pasture.
5 ditto just taken in hand, foul.
7 Keep upon thirty acres of water-meadow for six weeks in the spring, equal to one fourth the number of acres, or seven.

Total 188 acres; beside the run of thirty-three acres of turnips. But it is to be observed, that in the same ground sixteen plough oxen occasionally, but twelve constantly, were depastured; four horses occasionally, four cows constantly, till the after-grass: to this is to be added the run of yearling calves, and a large stock of pigs; and that the green crops of the spring and summer 1803, were unusually deficient in these districts. The sheep stock amounted to

302 lambs,
783 store sheep,

Total 1085;

The produce of them as follows:

Wool, 12 packs, 1 score -	*L. 446	0	0
216 store-sheep sold - -	409	3	0
132 fat sheep ditto and used -	238	16	2
Letting of rams - - -	524	10	0
	L. 1618	9	2

N. B. No sheep have ever been kept fattening older than four teeth. The fat sheep were all sold after being sheared, and the price of mutton, from the deficiency of keep, was not more than 4½d. at one part of the season.

J. F. LUTTRELL.
JOHN BRICKDALE.
W. JONES.

Fitzhead, June 2, 1804.

SOME OBSERVATIONS ON AN INSECT THAT DESTROYS WHEAT; SUPPOSED TO BE THE WIREWORM.

BY THOMAS WALFORD, ESQ. F. A. S. & L. S. WITH AN ADDITIONAL NOTE, BY THOMAS MARSHAM, ESQ. TREAS. L. S.†

The insect which is the subject of the following memoir has never, I believe, been noticed or described by any entomologist or agriculturist; its depredations are the annual topic of conversation with the latter, yet few know what insect it is, that destroys the wheat in the months of October and November, under the denomination of the wireworm. Many suppose it to be a *scolopendra*, others a species of *iulus*, and some the larva of a *tipula*, or of the *scarabæus melolontha* of Linnæus. I supposed it to be one of the above, till I found two insects in the very act of destroying the wheat, as represented in the annexed figure (Pl. VI. fig. 4, *a.*). These I believe to be the insects commonly, although very improperly, called the wireworms in Essex and Suffolk: they appear to me *larvæ* of one of the coleopterous tribe; but to what genus

* Five hundred fleeces of the above, at 15s. 8d. per fleece, amounted to 392l.

† Transactions of the Linnean Society, vol. IX. p. 156.

they belong can at present only be conjectured. The projecting jaws somewhat resemble those of a *lucanus*. The two jointed bristles, and the cylindrical tail, give it an affinity to *staphylinus*; but the *larva* of this insect is supposed to be carnivorous, and not graminivorous. I fear, therefore, that the genus of this insect cannot be determined, till it is traced to its perfect state.

I shall now proceed to relate the discovery of the insect, and to detail the injury supposed to be done by it.

In October 1802, having occasion to call upon an agriculturist*, whose skill and judgment in farming are rarely equalled, he informed me, that his green wheat was dying and losing plant very much, the reason of which he could not comprehend. I immediately suspected, that it was occasioned by the wireworm; but what kind of insect it was, I could not inform him. I therefore requested, that he would accompany me to the field where the greatest injury was done, in order that we might examine into it. This we accordingly did; and we were successful in discovering three of the insects in question, of which two were in the act of destroying the wheat, as above mentioned. With their projecting jaws these insects cut round the outside grass about an inch below the surface of the soil, to get at the young white shoot in the centre, which they eat: upon this, vegetation is immediately stopped, and the plant dies. I suspect, that they first eat the flour in the grains which has not been drawn up by vegetation; for, when we touched them, they ran into the husks; and two of the three insects I carried home in the husks, which appear to be their habitations, and probably the place where they change from the *larva* to their present state.

The injury which the public sustains by the ravages of these insects may, in some measure, be calculated from Mr Olley's loss in 1802: he sowed fifty acres of a clay soil with wheat; out of these ten were destroyed by them, which were replanted by dibbling in one bushel of seed per acre. The price of wheat at that time was eight shillings per bushel.

We here observe one fifth part of the quantity sown destroyed by these noxious insects; but the depredations of the wireworm, as I am informed by a friend† whose experience and observation enable him to calculate with superior judgement, being principally confined to wheat sown upon clover leys, old pastures recently broken up, pea and bean stubbles,

* Mr Thomas Olley, of Stoke next Clare, in Suffolk.
† Allen Taylor, Esq. Wimbish Hall, Essex.

&c., we may suppose the general average of the injury to amount to much less than a fifth (Mr Olley's loss): a twentieth part of what is sown upon this description of lands will, I think, be deemed a very fair and moderate calculation. The number of cultivated acres of land in England at the time above mentioned was computed at seven millions, of which 2,400,000 were calculated to be sown with wheat; and as only one half of the wheat annually sown is supposed to be upon clover leys, old pastures, &c., our calculations must be confined to 1,200,000 acres instead of 2,400,000: this will give 60,000 acres as annually destroyed by the insect in question; which replanted, at one bushel per acre, will require 60,000 bushels of seed, which, at eight shillings per bushel, are worth 24,000l. Besides this, although no extra expense is incurred by the farmer in preparing the land, yet he has to pay for dibbling in the seed, which, at five shillings and threepence per acre, will cost 15,750l, or, at the full price, six shillings per acre, 18,000l. If the land requires harrowing, there will be a further charge of ninepence per acre, or 2,250l. not to name other items, which render it difficult precisely to ascertain the loss of the farmer.

If the above calculation be thought a fair one, and I see no reason why it should not, we find the quantity of wheat lessened to the market by the depredations of these insects is very frequently, if not annually, sixty thousand bushels; which occasions to the farmers an additional expence of at least 15,750l.

I hope these observations will prove a spur to gentlemen more conversant in entomology and agriculture than myself, to excite them to inquire into this subject, the result of which must ultimately be beneficial to the public at large, by discovering some means of preventing the injury done by these mischievous insects. At present we know of no other than early ploughing, which is not always convenient to the farmer, as he wants to feed his clover land as late as the season will admit of. Unslacked lime has been tried without success*, although it is well known, if laid thick upon the land and ploughed in immediately, it will destroy insects of every kind, that are in the soil; but in many places the expense of procuring lime is too great to think of using it in sufficient quantities to answer the intended purpose†.

* Farmer's Magazine, p. 450.

† I am aware of its being said that part of the injury sustained is done by the grub of the tipula or crane-fly; but I beg leave to observe, that the injury done by the grub is in the spring, and not in October; as many of the flies have

As the drawing is from the accurate pencil of Mr Sowerby, no description of the insect is necessary.

Explanation of the Figures.

Plate VI. Fig. 2. The insect, natural size.
3. The same, magnified.
4. *a.* The same destroying the wheat.
— *b.* Hole in the husk, into which the insect ran upon being disturbed.

Additional Note, by Mr Marsham.

The above described larva is quite new to me, nor can I find any thing like it in the various authors I have consulted, who have written on the larvae of insects. I am therefore ignorant to which order it belongs. The name of wireworm seems to be given to various species of larvæ, but what I consider to be the true wireworm was sent to me some time ago by the Right Hon. Sir Joseph Banks. A figure of this I have added to the plate (Pl. VI. Fig. 5.). The history of this animal I found fully detailed in the Stockholm Transactions for the year 1777, by Mr Clas Bierkander, vicar of Gothene, near Skarra, under the appellation of root-worm. This larva, when full grown, is about seven lines long, very narrow, of a yellow colour, shining, and very hard: the head is brown, with the extremities of the jaws black. The body is composed of twelve joints, on the last of which are two black indented specks. It has six scaly feet on the fore part of the body. Mr Bierkander observes, that it remains five years in this state before it changes into a pupa, whence issues *elater segetis* of Linnæus. I have frequently found it both in fields and gardens at the roots of divers plants, but never succeeded in bringing it to perfection. The author above mentioned describes four other species of root-worms; viz. *musca segetis*, *musca hordei*, *phalæna turca*, and *tipula oleracea*.

I flatter myself, that this valuable Essay of Mr Walford's will stimulate other gentlemen who reside in the coun-

not deposited their eggs till the latter end of September, and those that are deposited earlier are few of them hatched before the spring, as was proved by Mr Strickney, whose pamphlet, entitled "*Observations respecting the Grub*," is now before me: therefore the depredations of the grub cannot be greatly prior to that time: besides, they are most plentiful in the fly state at the end of September and beginning of October.

try, and who are so materially interested, to enter seriously into a minute examination of the various causes, by which grain is so frequently destroyed; so that, by a number of such inquiries and communications, we may at length be enabled to point out a remedy—as every grain of corn that can be preserved in times like the present must be a public benefit.

Mr Bierkander's papers on the different root-worms I got translated by a friend; and the translation, with some remarks of my own, was some time since presented to the Board of Agriculture.

MEDICAL ART.*

OBSERVATIONS ON THE NATURAL SYSTEM OF MEDICAL SCIENCE IN GENERAL, AND NOSOLOGY IN PARTICULAR, PROPOSED BY MR WALKER.

BY DR JOHN HAMILTON.

TO THE EDITOR.

SIR,

I trust the following observations are neither altogether unworthy of a place in your very valuable work, nor of the extremely interesting subject to which they refer.

That our best systems of Nosology, not excepting that of Cullen, bring together diseases which are in their nature very different, and separate others which are in their nature closely allied, has long been felt and acknowledged by every philosophical physician; and that these are also the inseparable errors of all arbitrary arrangements is to me equally apparent.

It is indeed only by means of a natural arrangement, or a natural system, that such errors can be avoided.

The great difficulty, however, is to discover a truly natural system. Here I am ready to grant that the bases—

* The first of these communications belongs rather to science than to art; but was too late for insertion in its proper place.

Anatomy and Physiology, which you have adopted, are those which can alone afford it. I am ready to grant that your arrangement of Anatomy into locomotive, vital and intellectual organs, and of each of these classes into three orders is perfectly natural. I am also ready to grant that the application of this arrangement to Physiology by substituting the term 'functions' for 'organs'—the dividing of it into locomotive, vital and intellectual, and the division of each of these classes also into three is equally natural. I am even ready to grant (which is more to the purpose of this paper) that the continued application of the same arrangement to medical science by substituting the term 'diseased' for 'healthy functions'—the dividing of diseases into those of the mechanical, vital and intellectual functions, and the division of each of these classes into three orders, viz. the 1st into diseases of support, connection and locomotion; the 2d, into diseases of absorption, circulation and secretion; and the 3d into diseases of sensation, mental operation and volition is still equally simple, and equally natural.

But though I grant all this to be correct, I doubt whether it be not defective. Though I grant the doctrine of organs or anatomy to be correct, because it involves all the organs of which the more perfect animals consist, and places them in their relative situation; although I grant the doctrine of functions, or physiology, to be correct, because it appears to be strictly founded upon that to which it owes its existence, namely anatomy; and although I grant the doctrine of diseases, or nothology, to be correct, because it also appears to be strictly founded upon that to which it owes its existence, namely, physiology, yet I think a very few observations will actually shew this system to be extremely incomplete.

First, then, neither diseases of digestion, nor diseases of generation are involved by this system. Now, as these are two very numerous classes, and as this natural system makes no provision even for their introduction, it is obviously, in the first place, eminently defective. It is astonishing to me that its author has overlooked this.

Secondly: Nor are these its only defects; there are others, rather perhaps obscurities than defects. I do not, for instance, know how it is possible to distinguish between diseases of motion, and diseases of volition, as in both deviations from healthy action, the same effects must be produced.

I regret that these great defects and seemingly irremediable obscurities tend to subvert a system, which, from its being more simple and natural than previous systems, as well

as from its involving in their proper places, local diseases, which were previously placed under one arbitrary head, I should otherwise have preferred.

In urging these objections, I have been prompted only by the insurmountable difficulties which I felt upon these subjects, and have avoided stating various other objections which I have heard, such, for instance, as the objections that by this system the different stages of that which is generally termed one disease is thrown under distinct heads. This I certainly deem one of the greatest advantages of the system; for whenever correct practical treatment is not only different, but even opposite, it is absurd to reckon the disease the same; it may be useful to do so in common language, but certainly not in philosophical nosology, It is even with regret, then, that I think a natural system must be abandoned, and that we must rest contented with an arbitrary one.

If the preceding observations respecting the general system are thought to be of any value, I shall next transmit some respecting the situations which, in it, have been given to some individual diseases.

JOHN HAMILTON.

ANSWER TO THE OBJECTIONS CONTAINED IN THE PRECEDING COMMUNICATION.

BY THE EDITOR.

No contribution to the present work will ever be received with sincerer gratitude than those which urge objections to the doctrines which, in previous papers, I have delivered. The preceding paper, in particular, I deem valuable, because the author has judiciously stated the greatest difficulties upon the subject. Some of the very same objections, in the first instance, gave considerable trouble to myself. They now, however, appear to me to be very easily obviated.

As to the first objection—that no provision has been made for diseases of digestion and diseases of generation, I am convinced Dr Hamilton will see it to be unnecessary, when he considers that digestion and generation are not simple, but compound functions, and that every disease of them must, in

reality, be a disease of the simple functions of which they consist. Thus, digestion depends upon the muscular power of the stomach, upon the influx of gastric juice, and even upon the warmth to which the food is subjected in that cavity; a defect of any of these will evidently produce indigestion: indigestion is, therefore, not to be reckoned a peculiar disease, irreducible to derangements of the simple functions of the body. For, if it depends on the deficiency of muscular power, it is evidently a disease of diminished motion; if, upon a deficiency of gastric juice, it is as evidently a disease of diminished secretion; and if upon a deficiency of warmth, it is as evidently a disease of diminished circulation, &c. Nor would it be possible scientifically to prescribe for the patient who might labour under it, without knowing to which of these causes the disease was to be ascribed. The term 'indigestion' is of value in common or in general language, but is, in my opinion, totally insufficient for the scientific physician. The term 'indigestion' indicates little more than the seat of the disease, and is consequently a very insufficient guide for the physician; the ascription of the disease to a diminution of motion, or of secretion, points out the *nature* of the disease, and affords the clearest indication of its cure. The arrangement, therefore, of these affections, according to the natural system, is essentially necessary.

Precisely the same is to be said of diseases of generation.

The present mistake respecting both of these classes of disease, arises from not tracing them to those simple functions, on the derangement of which they depend.

As to the second objection—the impossibility of distinguishing between diseases of motion and diseases of volition, a little reflection completely obviates it also. . . All the operations of the mind are attended by consciousness, and were any one of these operations obstructed, we could not be conscious of its regular performance. When, therefore, we are conscious of the proper exercise of the will, and when, at the same time, the depending muscular motions remain unperformed, the disease is one of motion and not of volition. Thus are these diseases easily distinguished.

Thus, I trust I have satisfactorily, even to Dr Hamilton, obviated the objections urged in the preceding paper. I, nevertheless, deem myself particularly favoured by that communication, and shall think myself equally so by the promised one respecting my arrangement of individual diseases.

That, indeed, is the part of the system which is incomparably most liable to error, and, in it, I know several errors do actually exist. It has, however, I believe, the general merit of arranging diseases in an order so simple and natural that their theory is indicated by their arrangement.

I had almost forgot to mention, that, with regard to the general system, there is a considerable difficulty which Dr Hamilton has overlooked—a difficulty less easily solved than those which that gentleman has urged, viz. the difference between diseases of diminished absorption and those of encreased secretion, and also between those of encreased absorption and those of diminished secretion. This, indeed, I believe to be the only difficulty which now remains with regard to the general system. It is at least the only point in it about which I myself feel not entirely satisfied.

It will give me much pleasure to receive communications respecting this question, as well as respecting the arrangement of individual diseases *.

VIEW OF A NEW AND MORE RATIONAL PATHOLOGICAL THEORY AND PRACTICAL TREATMENT IN DISEASES OF THE GENERATIVE SYSTEM.

BY J. ROBERTON, M. D.

EXTRAORDINARY MEMBER OF THE ROYAL MEDICAL SOCIETY OF EDINBURGH, AND AUTHOR OF THE PRACTICAL TREATISE ON THE USE OF CANTHARIDES IN GLEET, LEUCHOROEA, SEMINAL EMISSION AND ULCERS, AND OF THE TREATISE ON MEDICAL POLICE, DIET, REGIMEN, ETC.

There are no diseases of such frequent occurrence, or such high importance, as those either actually existing in the generative organs, or affecting the general system in consequence of their long continued derangement.

In some of these diseases, and especially in those which are primary, such as gonorrhæa, lues venera, &c. there has too long existed a neglect of scientific discrimination and an undistinguishing routine of practice. This practice has its antiquity alone to recommend it; but, in consequence of this recommendation, weak as it certainly is, innovation, however scientific and beneficial, are ever timidly and slowly received.

* Since the publication of the last volume of the Archives, I have considerably improved the arrangements there delivered.

With respect to chronic affections of these parts, they have, more openly and generally than the primary, been acknowledged to be difficult of removal, and the majority of the most respectable writers on the subject have even asserted the utter impossibility of removing some of them. Indeed the avowed want of all success, except perhaps of the most temporary kind, which has uniformly attended the treatment of these chronic diseases, is a proof, which no unsupported assertion can overturn, that neither their nature nor treatment have been at all understood.

These affections, when nearly connected with the immediate parts, are, generally speaking, those beyond which medical men have not extended their investigations. But these, however important (for important they are in their nature, limited even in this degree), can never be compared to the dreadful ravages which in both sexes are at length invariably produced on the general system. The whole catalogue of human miseries often seem concentrated in the haggard and emaciated fabric of one miserable individual labouring under such diseases. That, too, which renders his situation lamentable beyond description, is the reiterated failure of those assurances of ammelioration which, at every change of prescription, he was confidently assured would yield him relief.

But when we consider the reasoning (if reasoning it may be called) which seemed to indicate the propriety of the practice employed, we shall not be astonished at these failures being even more frequent than at first sight they appear to be. The mistake takes place in the following way: When the body, from the continuance of such diseases, becomes affected with exreme debility, and when the mind also partakes of the general decay, the disease is falsely denominated either *hypochondriasis*, or a violent *nervous affection*, or something else which may permit some extremely difficult or utterly unintelligible definition, and the escape of the practitioner from further enquiry. For these, consequently, alleviation may be procured, but scarcely any mode of permanent relief.

Thus, however, the names of a long list of pretendedly incurable diseases has been invented; words have been substituted instead of facts; and the world is daily deceived by a repetition of similar mistakes.

During this absence of discrimination and of scientific treatment, the worst consequences arise from the insidious nature of these diseases. Although, perhaps, for many years, the general health of such patients is but now and then vio-

lently affected, and although such a state does not for some time threaten immediate dissolution, yet such affections are sure to increase in violence, and entail more and more irremediable mischief upon the system. Under these circumstances, when the most uniformly and speedily successful treatment ought to be employed, and either firmly persevered in, or altered according to its evident effects in the restoration of the patient's health, packet after packet of various medicines are alternately poured into the stomach, and accident, not scientific reasoning, is alone entitled to our acknowledgments, when such proceedings do *fortunately* no very material harm.

Thus these mistaken notions too often allow the affection to gain ground, and, in consequence of this, perhaps at no very advanced period of life, probably before the fiftieth year, the male feels totally unable to procreate, while the female is at an earlier period similarly affected, and perhaps soon after puberty disappointed in every hope of progeny.

Very early in practice, I acquired a dislike to those immense multitudes of different drugs, often possessing different, or even opposite qualities, which, at one time, were often crowded into all prescriptions, and which are even at the present day too often recurred to.

I may observe, that my attention was, several years since, first led to the treatment of some of the diseases of the generative system in particular, by perusing a publication by Dr Greenfield, written about a century ago, and containing some original observations on that subject. This book has many faults; but these, though they may tarnish, do not render useless its better parts. That gentleman, who was a man of learning and industry, treated diseases of the generative system in both sexes, and especially those of a chronic nature, by the internal use of cantharides. His success, as usual, excited the envy and malice of his professional brethren; and, in consequence of their intrigues, he was actually committed to Newgate on a charge of prescribing dangerous remedies for the removal of disease.

Though Dr Greenfield's account of the powers of this medicine be very extravagant, yet it has, in many points, internal evidence of consistency and truth. All the complaints in which it is there said to be useful, have one character—they are those of extreme debility, and therefore might all be rationally expected to be alleviated by one and the same means.

In a dissertation also on the venereal disease, written by Dr Turner about the commencement of the last century, that gentleman, after deprecating certain means employed for the

cure of gonorrhæa and gleet, proceeds to proclaim against Greenfield and the cantharides; but his philippic, in reality, contains a very high eulogium both on the person and the substance condemned; for Turner clearly discovers that he never gave the substance a fair trial, and, even amidst the most abusive invectives, he is obliged to bear testimony to the learning and medical knowledge of Dr Greenfield, as well as to the utility of the medicine which he recommended.

In the Philosophical Transactions of London, volume 5th of the abridgement, Mr J. Younge relates instances of the remarkable utility of the cantharides internally employed; but the same cases are much more fully narrated in Marten's translation of Greenfield's work, where Mr Younge, with the independence of a gentleman, vindicates the reputation of his instructor Greenfield.

The laborious Astruc gives an account of the internal use of this medicine, and names the principal medical men except Greenfield who exhibited it. He entertained an unfavourable opinion of the medicine, though he did not feel himself warranted utterly to condemn it.

Another author whom I may mention is Dr Forsten who, in 1776, published a profound and useful Essay on the internal and external uses of Cantharides, in which he gives a learned account of the opinions of the best authors both ancient and modern, concerning them.

It does not, however, appear, that even by any of these men, the medicine was scientifically used, or managed with that caution which is indispensible to its successful exhibition; and this it undoubtedly was that excited the general outcry against it.

Now wherever (as in the present case) strong controversial disputes prevail respecting the qualities of drugs, either mistake or some other motive than the developement of truth in general actuates one or other of the disputants. Under such circumstances, great caution in proceeding upon the opinion of either party, is strictly necessary; but such caution as will prevent our ascertaining the extent of the power of a substance which has been allowed in many cases to possess properties of unappreciable value, can never be approved of, even by the most timid. By incautious conduct, we must from time to time commit faults even with the most common medicine; we know, that unless caution is used, even the articles of our common diet may produce much mischief. This caution, however, carried to too great a pitch, which is even more common than the last mentioned fault, completely prevents

us from obtaining a knowledge of our most useful remedies, and consequently of ever effecting a cure of the numerons diseases which can *alone* be removed by the well regulated administration of them.

In proceeding with my investigations respecting the powers of the Cantharides, I had no theory to establish, nor any wish to deceive myself or others by a detail of results which were only to be of momentary duration; especially as I possessed none of those qualifications or advantages which can recommend and support any point long after it has ceased to possess merit enough to recommend itself. I, therefore, determined to regulate my opinions on this subject by the permanent result of its action in the removal of affections in which I had found it useful. The obtrusion of facts, much more rapidly than I at first expected, opened to me in a long list of diseases—a field of new and successful practice which, in the first instance, absolutely astonished me.

In my first publication upon this subject, nearly three years ago, I laid before the public the result of that practice. None of the rules then adduced have been disproved by my practice since that period, but, from the same train of reasoning, greater and what I deem still more important facts daily obtrude themselves npon me. These I shall soon lay before the public.

In my first publication, including an examination of the nature of Gleet, Seminal Emissions, &c. and of many female complaints, and also a detail of the successful application of the medicine to such affections, I had not so decidedly ascertained, at least to the extent I have now done, the theory of the action of the Cantharides in the removal of the disease. I now find it proved, in the most satisfactory manner, that when the generative system is reduced to the very greatest state of debility, and when the whole system (which is not uncommon) may have partaken of this debility, giving origin to a variety of the most distressing symptoms in both sexes—I find, I say, that by the judicious administration of Cantharides internally, the parts evidently recover their healthy tone, and are completely enabled by their own power, after the Cantharides are discontinued, to perform those healthy functions of which they have previously been utterly incapable.

I find also that instead of such complaints of both sexes being of a complicated nature (as in this light we have all been taught to consider them) there is an uniformity and extreme simplicity, respecting almost every one of them. The practice in them is consequently equally simple.

I now then proceed to the proper object of this paper, viz. clearly and briefly to exhibit both the theory of the class of deseases to which the medicine is applicable, and that of the medicine itself. To these, I shall subjoin a few of the more important practical rules for its use.

1st. With regard to the diseases, innumerable circumstances show them to be purely those of debility. In a majority of cases, we can trace their existence to a previous overaction of the whole sanguiferous system which is acknowledged by every one to be productive of debilitating effects. But more commonly they are such as depend on a similar overaction of this function in some particular series of organs; most commonly in those of the generative system. In the latter case, it is, after the continuance of the disease and during a considerable length of time, by no means an uncommon occurrence for the general system to become remarkably affected with various other forms of diseases, all of which, varied as they may appear, can only be permanently removed by restoring the tone of the parts the loss of which first occasioned them.

Those diseases are, in the male, Seminal Emission, Gleet, Stricture from debility, &c. Those in the Female are, Leucorrhœa, Chlorosis, Dysmenorrhœa, Menorrhagia, &c.

According to the length of continuance or the severity of these complaints, we find various functions of the body variously impaired. The powers of digestion fail, and occasional vomiting is by no means uncommon; the bowels are in general constipated; the muscular parts of the body become soft and flabby and a paleness and inability for exertion affects the whole. The sight too, and hearing and memory are, especially in severe cases, very considerably impaired; so much so, indeed, that I have known some patients totally unable to follow any occupation, or indulge in any amusement where the exercise of either of these faculties was absolutely requisite.

In such states, then, it is by no means uncommon for one or more of the most valuable faculties to be irrecoverably destroyed, and the body is likewise thus rendered extremely susceptible of various other diseases by which are lost many thousands of valuable lives which, had the primary affection been early enough attended to and properly treated, might have been saved.

2dly, With regard to the medicine, innumerable circumstances show, that its wonderfully beneficial effects are owing to its universally stimulating properties.

Its action on the general system, is, almost from the commencement of its admistration, distinctly perceptible, by means of its effects on the pulse. In a longer or shorter time, accord-

ing to various circumstances connected with the constitution of the patient and the state of the disease, the debility and soft flabbiness of the muscular parts gradually disappear, and, with the exception of but very few cases which have come under my observation, the patient becomes stout and of a healthy appearance.

Various very curious circumstances have also occurred to me in my practice with the Cantharides, especially when the urinary organs where violently affected by an overdose of that medicine, which strongly indicate the same mode of operation of the medicine. I have, under these circumstances, observed great quantities of coagulable lymph secreted, probably by the inner surface of the bladder, and evacuated with the urine. In one of these cases, in which the above circumstance had frequently occurred, I observed that there was also secreted a considerable quantity of seemingly chalky or calcareous matter which was easily separated from the urine. From the same cause also, I have observed the urine highly tinged with blood.

These increased dozes, however, seem to me quite unnecessary for the cure of any disease, and scarcely ever occur except by mistake of the patient or from his too great anxiety, soon to get well. But it is a very pleasant reflexion that, independently of the very greatest degree of action into which these parts can be put by such overdozes, no inconvenience or after-distress to the patient was ever, under my observation, occasioned by it. The story, so prevalent, then, of irritation of the bladder, or of the neighbouring parts from the violent or even, as has sometimes been talked of, from the slightest effects of the Cantharides, is ridiculous. I myself have never seen it, and I believe it to be only a convenient excuse for those who start doubts from ill nature, and endeavour to maintain them by falshood.

But what I deem one of the most important facts, respecting the effect of the Cantharides on the system, is the possibility of using it for any length of time without inducing the debility so inseparable from the continued action of any other stimulant medicine. With this medicine, also, it is, in general, unnecessary progressively to increase the dozes; for, by its continuance, it does not lose its effect on the system; on the contrary, the longer its use is persevered in, equally stimulant effects may be produced by smaller dozes of the medicine. I myself have frequently given it for a year, and once or twice for about eighteen months, at the expiration of which, the patient was stouter than for many years before.

The general circumstances which contra-indicate the administration are few, such as a general inflammatory state of the whole system or of some particular organ nearly connected with existence, and a tendency to the formation of tubercles in the lungs, the inflammation of which it might accelerate. The particular and more trifling circumstances, which contra-indicate the use of this substance, will be better and more certainly understood by careful attention in the administration of the medicine than by perhaps any regularly stated directions respecting them.

In beginning the treatment of the previously enumerated diseases, the dozes of the tincture of Cantharides, prepared according to the London Pharmacopeia, are about two drams divided and taken in water, in three proportions, in the course of 24 hours. These dozes ought to be gradually increased, whatever the quantity necessary for that purpose may be, till the urinary organs become slightly affected by its use. In my own practice, I have found that, in different individuals, from two drams to two ounces may, from various constitutional circumstances, be used daily. It ought, however, always to be recollected, that the rules which contra-indicate the use of this medicine, previously stated, ought first to be attended to, and next that that degree of action in the urinary organs must ultimately be produced, which indicates its influence on the general system. When this state has been effected by judicious perseverance, we at length, by removing the morbid action of the parts enable them to perform their proper functions.

When, by accident or inattention, disagreeable effects are produced by the Cantharides upon the urinary organs, they are easily obviated by temporarily abandoning the medicine, administering a brisk purgative, and applying warmth to the abdomen.

I shall decline, on the present occasion, saying more upon this subject, as I have now in the press a work on the diseases of the generative system of both sexes where I have treated the subject much more extensively than can be expected in any limited paper.

I may be allowed to make one concluding remark, that almost all the class of diseases of which I have now given a brief pathological and practical sketch, were, previous to my investigations, either openly avowed or found to be incurable; and it affords me no small degree of gratification to find that, whenever the liberal and candid have followed similar plans, they have, after a little practice, been as successful as I have been.

JOHN ROBERTON, 12, *Princes Street.*

OBSERVATIONS ON THE TREATMENT OF HYDROCEPHALUS.

BY DR ROBERTON.

There are perhaps no diseases, the nature of which is so little understood, as many which are daily to be met with among infants and children.

In the present very imperfect state of our art, even with all the advantages of the most minute detail of their complaints, which those of maturer years are capable of giving, we are often much perplexed, and frequently bewildered, in our attempts to account for various derangements in the animal economy. In children, we have not even the advantage of the communication of their feelings by words, consequently their complaints must be a matter of still greater conjecture than those of individuals of maturer years.

Fortunately, however, in regard to the more important symptoms in the complaints of children and infants, there seems less variety than we find in those of adults: consequently room for conjecture and error in their treatment is less extensive, and our chances of success from following general rules are more certain.

In these complaints, as well as in those of almost every other sort, we too often have ourselves to blame for our want of success. This often arises from our taking for granted what had been previously said by others without thinking for ourselves, and from our overlooking the more general affections of the system, and applying a multitude of inefficacious, if not hurtful, drugs for the removal of trifling symptoms, while the more important ones are permitted to commit, on the system, the most dreadful ravages, which must ultimately, if unchecked, destroy the existence of the patient.

On the present occasion, I would more particularly apply this remark to *hydrocephalus internus*, or water in the head. I am of opinion, now that small-pox has been driven out of this country, that this is *the disease* of children—that as many, if not more, die of it as ever did of small-pox.

The names which we have been in the habit of applying to this affection, such as *weaning-brash*, *bowel-hive*, *milk-fever*, *draughts*, *convulsions*, &c. while they yield no information to the scientific enquirer, only serve to bewilder the generality of people respecting its real nature. It will, however, be at all times found, that upwards of ninety patients in the hundred who die of any of what is known among nurses, old women, and old women practitioners of physic, of which there are not a few, by the above and some other as absurd names, will, on opening the head after death, be found to have water in the ventricles of the brain.

Now as effusion of this nature can only take place either in consequence of previous inflammatory action, or from a long continuance of debility, this effusion must be caused by one or other of these affections. Certainly then, the medical attendant, if he knows any thing at all beyond his *bow*, and too often his ridiculously affected *grimace*, must be able to ascertain to which of these states the system is most liable during the prevalence of certain symptoms, and previous to the termination of this disease by effusion. This is indeed at all times easily known by the state of the pulse, and by the general habit of the body of the patient.

In by far the greater number, a general inflammatory state of the system prevails previous to effusion into the ventricles; and certainly, in this form of the disease, it is much more manageable than in the other, where every individual function has become debilitated—often beyond the power of the most active remedies to restore them to any permanent degree of healthy action.

The degree of torpor of the system, in that which is the second stage of this disease, is astonishingly great. I have always seen this state of the system encrease a longer or shorter time before death according to circumstances. I have even seen the body become so torpid, that neither warm baths would warm it, nor would any sort of blisters materially affect the skin. As this, however, is rarely present in the commencement of that diseased action, which if unchecked almost always terminates in effusion into the ventricles, we have ourselves to blame if ever we allow it to supervene.

To avert fatal consequences, we ought to attend to every particular change in the child's health; most of these changes being of an inflammatory nature, and likely, if unchecked, to terminate in effusion of fluid into the ventricles of the brain. It is by inattention to these general though trifling occur-

rences, that many hundreds of children daily fall victims to effusion of water in the brain.

Whatever in these cases may be the particular nature of the action of vesicatories applied over the whole head, they are, assisted by cathartics, &c. most effectually beneficial in the prevention of that effusion in the brain, which, if not prevented, can never be removed, and must terminate the life of the patient.

Thus a blister over the whole head, purgatives till the stools become of their natural colour (for in such a state of the system they are usually green, brown or black), with the occasional application of leeches to the temples, or the abstraction of blood from the jugular vein (for the pulse is in general full), are extremely proper, and even absolutely necessary. These applications, especially blistering the head, provided the symptoms do not abate, require frequent repetition. Indeed, even independently of symptoms of general debility, provided the pulse continues fuller and quicker than natural, all the means above mentioned must be repeated and persevered in. It is alone by this active practice that we are to expect decided success in the treatment of such complaints.

ON THE MOST ADVANTAGEOUS MODE OF PROSECUTING MEDICAL STUDIES.

BY THE EDITOR.

In order to effect a rapid and sure progress in the prosecution of all studies, nothing is so essential as a simple and natural method. In medical studies, this is especially requisite, in consequence of the great diversity of subjects which they necessarily embrace. In no kind of study, however, has simple and natural method been so little adopted.

Natural history, which in general refers chiefly to the external characters of animals, is sometimes preposterously studied after anatomy, which explains their internal structure; botany, which considers the external form and internal structure of plants, is often, with equal absurdity, studied after materia medica, which explains their applications; the practice of medicine is often,

with not less absurdity, studied before the theory upon which it ought to be founded; and, with absurdity still equal, whatever portions of the practice of medicine have in them any thing of mechanical operation, are arbitrarily and most unnaturally patched together under the name of surgery, although they cannot possibly be either separately studied or separately practised.

Even in the *general* plan of study, then, there are numerous other mistakes every day committed, not less important than these. To enter into their particular enumeration would not be an agreeable task, and may be advantageously avoided by delivering a general method, which is at once simple, natural and impressive.

With regard to the general arrangement of studies:

I. Mineralogy and chemistry; botany, vegetable anatomy and vegetable physiology; and natural history, anatomy and physiology, which refer entirely to health, if all introduced into a course of medical study, ought to be studied before any of the sciences which refer to disease, and which I shall subsequently mention. They ought also to be studied precisely in the order in which they are here enumerated.

1. MINERALOGY, if studied, ought to be studied first, because minerals are more simple in their structure than either vegetables or animals, and also because they afford the materials of which these are composed. It ought even to be studied before chemistry, because it affords almost all the subjects of chemical operation.

2. CHEMISTRY ought to be studied immediately after mineralogy, because it considers the actions of the substances of which mineralogy merely describes the structure, and, as it is thus immediately dependent on mineralogy, it necessarily, along with it, precedes botany.

3. BOTANY, if studied, ought to be studied immediately after mineralogy and chemistry, because it considers the bodies which are next in simplicity, and because the vegetable objects which it describes owe their elements to mineral substances. It ought to be studied before the sciences which refer to animals, because they consider objects which are more complex than its subjects, and also because the subjects of botany afford many of the elements which enter into the formation of the animals which these sciences consider. It ought

also to be studied before vegetable anatomy, because the external form of plants should be understood before their internal structure.

4. VEGETABLE ANATOMY ought to be studied immediately after botany, because the internal structure ought to be studied immediately after the external forms of plants. It ought to be studied before vegetable physiology, because the actions of the parts of plants cannot be understood before their structure is explained.

5. VEGETABLE PHYSIOLOGY ought to be studied immediately after vegetable anatomy, because it considers the actions which the preceding structure performs, and, as it is thus immediately dependent on vegetable anatomy, it necessarily, along with it, precedes animal anatomy.

6. NATURAL HISTORY ought to be studied after botany, vegetable anatomy and vegetable physiology, because it considers the bodies which are next in simplicity, and because the animal objects which it describes owe many of their elements to vegetable substances. It ought to be studied before anatomy, because the external form of animals, which it considers should be understood before their internal structure.

7. ANATOMY ought to be studied immediately after natural history, because the internal structure ought to be studied immediately after the external form of animals. It ought to be studied before physiology, because the actions of the parts of animals cannot be understood before their structure is explained.

8. PHYSIOLOGY ought to be studied immediately after anatomy, because it considers the actions which the preceding structure performs, and, as having a reference only to health, it necessarily immediately precedes the following series of sciences which refer to disease.

II. Pathology or the theory of diseases, morbid anatomy, materia medica and pharmacy, and the practice of medicine, which refer entirely to disease, ought to be studied after the sciences which refer to health. They ought also to be studied precisely in the order in which they are here enumerated.

1. PATHOLOGY, of all these, ought to be studied first, because it affords the basis of all the subsequent operations. It ought also to precede morbid anatomy, because it explains those actions which *terminate* in the states described in morbid anatomy. Pathology may, therefore, be thus considered as a cause, and morbid anatomy as an effect.

2. MORBID ANATOMY ought to be studied immediately after pathology, because it describes the various states which are induced by the actions considered in pathology. It ought also to be studied immediately before materia medica, &c. which refer to the removal of these states, because the states must be understood before their removal can be thought of.

3. MATERIA MEDICA and PHARMACY ought to be studied immediately after morbid anatomy, because they afford the means of removing these states. They ought to be studied before the practice of medicine, because no practice can be adopted without previous possession of these means.

4. THE PRACTICE OF MEDICINE and the OPERATIONS OF SURGERY ought to be studied immediately after materia medica and pharmacy, because the use ought immediately to follow the possession of the means.

With regard to the time which these studies ought to occupy, three, or at most four years are amply sufficient.

In the winter of the first year, ought to be studied mineralogy and chemistry: in its summer, botany, vegetable anatomy and vegetable physiology.

In the winter of the second year, these sciences ought to be reviewed; and natural history, anatomy and physiology ought to be studied. . . The review of the preceding years studies will occupy very little time; natural history, generally considered, will not occupy much; anatomy and physiology will be entitled to the greatest share of it, and actual dissection will be so in an especial manner. Nor is this period, if both lecturer and pupil do their duty, by any means too shor for the acquisition of these sciences. . . The summer of the second year ought to be occupied with the continued review of the preceding sciences, especially with the last—anatomy and physiology with dissections; and pathology and morbid anatomy ought now to be studied.

In the winter of the third year, the preceding sciences ought still to be reviewed, especially anatomy and physiology, with dissections, and also pathology and morbid anatomy; and materia medica and pharmacy, and the practice of medicine, ought now to be studied. The summer of the third year ought to be similarly employed. And, during both the summer and winter of this year, an hospital ought to be attended.

If, instead of three, two years only can be given to a regular course of medical studies, the pursuits assigned to the first year must be omitted, excepting chemistry, which must be substituted in lieu of natural history, mentioned at the commencement of the second winter's studies.

Those, however, who can employ four, instead of three, years, ought to employ the last in a continued revision of preceding studies, and especially in attendance at an hospital; so that the period of actual practice may be enlarged.

To attend an hospital, however, before the study of the practice of medicine and surgery has been begun—that is, in the third of a three years course of study, or in the second of a two years course, such as I have described, is utterly useless, except to those who may have previously studied at another school or university.

With regard to the particular arrangement of studies.

Conspicuous errors of this kind are first made in the modes of teaching and of studying anatomy and physiology.

The muscles are sometimes described before the ligaments, although it is impossible to understand the actions which the muscles actually perform without previously knowing the motions which the attachments of the ligaments permit. The arteries are often described before many of the viscera, although it is impossible to understand their course without previously knowing the structure of these viscera. The arteries are always described before the absorbents, although, did the absorbents not precede them both in existence and in action, the arteries would be destitute of blood.—But I need enumerate no more errors of this kind: they are within the reach of every one's daily observation.

No order of studying anatomy and physiology is advantageous either to the teacher or the pupil except the natural one. That is, the organs and functions which I have termed mechanical or locomotive ought to be described first; next those which I have named vital; and, lastly, those which I have denominated intellectual. Under the locomotive, ought first to be explained the bones, or organs of support; secondly the ligaments, or organs of connexion; and, thirdly, the muscles, or organs of motion: under the vital, ought first to be explained the absorbing surfaces and absorbents, or organs of absorption; secondly the heart, lungs and bloodvessels, or or-

gans of circulation; and, thirdly, the glands and secreting surfaces, or organs of secretion: under the intellectual, ought first to be explained the ear, eye, &c. or organs of sense; secondly the brain, or organ of mental operation; and, thirdly, the cerebellum, nerves, &c. or organs of volition.

Although this order has never been adopted, yet every deviation from it is no less a deviation from the natural and the most advantageous method of study.

(*To be continued.*)

PATENT OFFICE LIBRARY

ARCHIVES

OF

UNIVERSAL SCIENCE.

PART III. REVIEW.

1. CONSIDERATIONS ON THE CAUSES, OBJECTS AND CONSEQUENCES OF THE PRESENT WAR, AND ON THE EXPEDIENCY OR THE DANGER OF PEACE WITH FRANCE. BY WILLIAM ROSCOE, ESQ. *Cadell.* 1808.

2. A LETTER TO WILLIAM ROSCOE, ESQ. CONTAINING STRICTURES ON HIS LATE PUBLICATION, ENTITLED, "CONSIDERATIONS ON THE CAUSES, &c." *Longman.* 1808.

3. A REVIEW OF MR ROSCOE'S "CONSIDERATIONS, &c." *Chapple.* 1808.

REVIEWED BY THE EDITOR.

THE pamphlet of Mr Roscoe considerably excited the attention of the public, and although many leading points of its argument were satisfactorily refuted by several replies of considerable merit, and among others by the two mentioned above, yet a principle which ought to have been fundamental

both to that work, and to all the replies to it, has by all of them been neglected—I mean the cause of those disasters which have occasioned every dispute on this subject.

As the subject in general is, however, eminently important, I shall here take a survey of the whole of it, and, in doing so, shall at once consider Mr Roscoe's work and the replies to it.

With regard to the causes of the original war, I do perfectly agree with Mr Roscoe. There existed blame and mismanagement on every side. It was, in the very first instance, unauthorised.—But, in viewing the results of this war, I never can agree with Mr Roscoe, that the price which, as he says, France has been compelled by Europe to pay for that which, in a subsequent part of his work, he calls her independence on foreign powers, is a cheap one. France never was, in any period of her existence, more oppressed than at the present moment; and if she have made a purchase, its effects are yet to be seen. I know, however, that she has made one, but it is in a different view from Mr Roscoe—its best effects will alone be evidenced in the very downfal of the present system.

Less still am I of opinion, that "the *present* contest owes its origin to persons who were willing to sacrifice the best interests of their country to their own exasperated feelings and mercenary views," or as he elsewhere expresses it, "to the passions of the wicked and the fears of the weak." Mr Roscoe pompously boasts of his temperate language to France, but forgets, that, in addressing such language to his countrymen, he commits a much greater error than they do in addressing it to the enemies of Britain.—Are we to conclude from this, that Mr Roscoe has more regard for the feelings of the common enemy of liberty and of Europe, than for those of his fellow citizens? Such a suspicion I would not cherish with regard to so distinguished a philanthropist as he, but I trust that reflection upon this subject will, in future, prevent him from railing against those who merely apply the justest epithets to the destroyers of liberty and the enemies of Britain.

Neither do I think with Mr Roscoe, that the language used either in Britain or in France was, in any considerable degree, a cause of the war. It was, in England, precisely an expression of indignation against that eternal encroachment on the part of France which prevented the possibility of peace. The just causes of warfare were sufficient without such trivial excitements. Even the retention of Malta was not its worthiest object.

It is also an essential error of Mr Roscoe to say, that, " though in England such language is independent of the government, and in France its very act and deed, and though that may be held to be a good distinction here, it is not so to the rest of Europe." The gentlemanly answer of Lord Whitworth to Buonaparte is the only notice it deserves, namely, that " sueh language would gradually subside, if not kept up by the policy of either party," and indeed it is only so far as it is the language of the government that it is the business of Eu- to notice it.

The vulgar and childish complaint of Buonaparte, that " *every wind* which blew from England *brought nothing but enmity and hatred* against him," or that Georges and his *bitterest* enemies were protected," are too contemptible to be dwelt upon.

The general and vague language of the country, however, was only a pretext. It was the liberty of the press which excited the alarm of the French government, and against which it dared to complain. M. Talleyrand, upon that subject did not hesitate to hint that " every nation is at liberty to sacrifice *any advantage whatever* in its interior, in order to obtain *another* to which it attaches a higher value." So direct was the demand, and so unequivocally was this the great question that Lord Hawkesbury was under the necessity of making the following reply, namely, that " His Majesty cannot, and never will, in consequence of any representation or menace from a foreign power, make any concession which can be in the smallest degree dangerous to the liberty of the press, as secured by the constitution of this country."

But even all this was not the cause of the renewal of hostilities. Is it possible that Mr Roscoe can forget that while with the best good faith and equal good nature, we were assiduously disbanding regiment after regiment; dismantling ship after ship; and giving orders for the surrender of places, Buonaparte was annexing Piedmont, the bulwark of Italy to France, crushing in the dust the German constitution, and bringing under his uncontrouled influence the states of the empire; was subjugating Switzerland, oppressing Holland, exciting war in India and rebellion in Ireland; was with unparalleled rapidity increasing his own navy, and sending spies to sound our ports? Is it possible that Mr Roscoe can consider these things, and still assert that " the war had no foundation in any substantial cause?"

But that Mr Roscoe should be deceived by the tyrant's assertion that " If he had not felt the enmity of the British

government on every occasion since the treaty of Amiens, there would have been nothing that he would not have done to prove his desire to conciliate—participation in indemnities as well as in influence on the continent, treaties of commerce; in short, any thing that could have given satisfaction, and testified his friendship," or that "two such countries, by a proper understanding, might govern the world"—that Mr Roscoe should observe that "if this offer had been attended to and improved upon, it might not only have given peace to Europe, but have placed Great Britain beyond the reach of danger from any power on earth," "if peace," says he, "had been the object of the British ministry, here was the ground-work of it; if security, here was the season for finding it; if aggrandizement, this was the opportunity for obtaining it"—this, I say, is to me more than amazing. Can Mr Roscoe forget that it is of some consequence to consider the character of the person who makes these offers; that it is of some importance to investigate a single instance of his conduct. Let us chuse the most recent example—He has conferred peace, security and aggrandizement upon Russia; she shares with him the controul of the continent; while Buonaparte is the emperor of the south and the west, the Czar is the emperor of the north and the east. But here we, in a moment, discover that her share is indeed a small one, and the real extent of his empire is almost in the inverse ratio of the extent of his titles. Britain, Mr Roscoe forgets, would scorn such aggrandizement, and, instead of envying all this, most cheerfully expends her blood and treasure to avoid it.

There were doubtless in the character of the great Pitt many blemishes; to his ignorance of the most liberal policy, France, to a certain degree, owes her elevation; but I never will, with Mr Roscoe, blame the vigor with which he carried on the war after the treaty of Amiens. It was by this, and by some of his preceding conduct, that "he opposed the most effectual barrier to the tyranny of France."

Mr Roscoe equally errs, when proceeding to the fate of the subsequent campaign, he attributes it to the jealousy and dissension of the Austrians, the neutrality of the Prussians, or the mere promptitude and rapidity of the French. It was want of military talent that ruined Austria; the same want would (only a little earlier) have ruined Prussia, had she then co-operated, and it was the possession of such talent that aggrandized France. The case of the two parties was positively that of two people who sit down to chess, and of whom one is ignorant of the game, or knows little of it, while the

other plays upon the most scientific plan. In such a case, who could doubt the issue of the contest?

The subsequent union of Mr Fox and Lord Grenville I rejoiced at as well as Mr Roscoe; their conduct in the negociation, and regard for the interests of Russia, *I more unqualifiedly admired*. But the retention of Sicily alone was the reasonable *sine qua non* of Russia: Dalmatia, of which Mr Roscoe says so much, was only expected by her.

With regard to Mr Fox, at the commencement of the business, indignantly driving the assassin from his presence, it was what every man who knew him would have expected; but, in sending an account of the transaction to Mr Talleyrand, he at once acted unnecessarily, and added another error to the great one which, from his excessive simplicity, and mistaken liberality, he committed in visiting the tyrant at a time when he had effaced the shadow of liberty in France, and when its best friends in that country were either languishing in his chains, or writhing under the tortures of his assassins, instead of considering him as a monster who disgraced humanity by his unparalleled accumulation of crime, and formed an infinitely more legitimate object of abhorrence than the poor wretch imposed by M. Talleyrand upon his wonderful simplicity as an assassin, could have been, even if he really wished to extirpate the monster. And as to Mr Fox's receiving the assurance that the First Consul recognised in him honourable sentiments, &c. when we consider that it came from a man who from Corsica first introduced into France the fashion of secret assassination, it renders the whole scene even ludicrous in the extreme.

That the pretence of assassination was the contrivance of M. Talleyrand is first probable, from his instantly taking advantage of it to make propositions, and is next confirmed by the very manner in which he made them... M. Talleyrand sends first a letter of thanks to Mr Fox, in which there is no hint of amicable arrangement, and afterwards, but in the same day, as if he had not, till that moment, thought of it, he drops him a note merely observing that it was a pity some arrangement was not entered into between the two governments. Likely indeed that M. Talleyrand should be so forgetful of pacification as to need to send two letters of a morning to England! The trick was very obvious and contemptible. And had this great statesman recollected a passage in my favourite author* "I knew one, that when he wrote a letter, he would

* Essays Civil and Moral. Of Cunning.

put that which was most material in the postscript, as if it had been a bye matter," he would not have been imposed upon.

Better than this, I like the *dignified prejudice* of Mr Pitt, though I by no means intend either to approve of it, or to draw any contrast between the characters in general.

That Mr Roscoe has most fairly stated the subsequent question of the *uti possidetis*, I grant, and that Buonaparte was sincere in his wish for peace upon other principles, I no more doubt than he. But, that sincerity of wish, and good faith in performance are not inseparable, it is only necessary to refer to the conduct of Buonaparte to Prussia at the same instant of time. He had pleased her, for a period, with Hanover, and, though her firmest ally, now plundered her of it similarly to please England for a period. For it would be absurd to suppose that he would have been more faithful to Britain than to Prussia. The man who, as his interest directs, robs one to benefit another is equally to be dreaded by every party.

In opposition to Mr Roscoe, I cannot help applauding that ministry who espoused the cause of Prussia, and who so far forgot their own injuries in avenging hers, or who perhaps rather thought they could make her the means of overturning the power of France. It is the business of every reasonable man, it was the bounden duty of ministers, to consider which of two evils was the least.

They did well to contemn the proffers of M. Talleyrand, who, in consenting to relinquish Hanover, Malta, and the Cape, childishly told them that "Hanover was for the honour of the crown, Malta for the honour of the navy, and the Cape of Good Hope for the honour of the British commerce." They did well to laugh at his childish offer of Pondicherry and Chandenagore—What were these to Holland, Spain, and Italy?

When reflecting upon the fate of this campaign, Mr Roscoe speaks of the "Prussian monarchy being overturned in the course of a few days by the newly formed armies and inexperienced conscripts of France," he forgets the cause of their success and of the misfortunes of Europe. It was the superior skill of the French generals that subverted Prussia. When he afterwards says that mere promptitude is the distinguishing characteristic of the French armies, he in this shows himself ignorant of the same principle. Was it to be expected that, in the battle of Jena, Prussia could cope with France, when, instead of numerous scientific officers, she wanted even

a commander in chief; for the duke of Brunswick fought in the lines, and consequently commanded only his own regiment.

As to the rejection of the mediation of Russia after the peace of Tilsit, it was the noblest act of the present administration. Nothing could be more utterly inconsistent with the dignity of Britain than to have the power of making propositions, limited to a month. Besides it was impossible she should accept the interference of that base power who mediated only to plunder Prussia.

I cannot help entirely acceding to Mr Roscoe's opinion respecting our conduct to Denmark, "that certainly the perpetrators of that act have incurred a responsibility for which they no doubt must ultimately give a solemn account," and I fear it is not in their power to give a satisfactory one.

Certainly if Denmark was defenceless, we were bound by every law to defend, instead of plundering her. The Danes accordingly recognized in us only friends and protectors. And had we acted as the most obvious morality demands, the high honour of Britain would have formed a glorious contrast with the unprincipled character of France, and all that is great and independent in Europe would have rallied under her flag.

Denmark then was only threatened by France, and not unfaithful to Britain. That she had no intention of injury to us is most evident from this, that, at that moment, there were 350 of her ships and two millions of her property in our ports, nor did she ever attempt to withdraw them. On the contrary, the Danish council of commerce assured the merchants to whom the ships belonged, that there could be no rupture between the countries, and consequently no danger to their property. The man must be insane who would argue, that a government intending war with us would thus have deliberately thrown into our hands such immense property of her subjects. Nay the warmest advocates of our conduct have not been able to adduce the slightest proof, that measures hostile to England were intended by Denmark. In the declaration which forms their apology, they are able to assert no more than that Denmark was endangered by France.

Now, with the aid of Britain, the Danes could most successfully have defended Zealand. It is, as Mr Ponsonby observed, above 150 years since an army passed on the ice from the main land to the Danish islands. Individuals rarely venture to pass the Great Belt. It is besides notorious that the frost

is less intense in the north of Europe than it was in former periods, so that there was not even a probability of a practicable passage between Holstein and Zealand, far less of a frost of such continuance as would have enabled a French army to manoeuvre with the slightest chance of success against a concentrated and prepared one of Danes and Britons.

But even granting, for the sake of argument, a probability where there is none, ought we to rival or rather ought we to anticipate the iniquities of France. Such a proposal either of the great predecessors of the present administration—Mr Fox or Mr Pitt, I believe, would have rejected with horror. It was, by adopting the converse of this principle, that they maintained the honour and dignity of Britain. Robbery and murder excused under the pretext of cruel necessity ! ! ! Such a maxim, Mr Roscoe beautifully observes, as that of cruel necessity even between belligerent powers is all that is now wanting to complete the downfall of Europe, and destroy the hopes of the human race.

Let us for a moment reflect upon the cruel fate of the Danes—The British approach, are welcomed as allies, advance under the sacred banners of friendship. But their fleet is stationed, their purposes are effected, the mask is thrown aside. Now terror and consternation seize the wretched citizens. The unparalleled treachery of their new enemy—a conviction of the rectitude of their own cause, rouse the justest indignation. As is the duty of brave men, they bravely resist. But alas ! the young and innocent who know not whither to betake themselves, the aged, the weak and the helpless, neglecting the hard earnings of a life of labour, and wildly searching in the confusion for those beings who alone may be dear to them, are, as well as the manly and brave soldier, in every street mowed down and burnt by the fire of their relentless enemy, or inveloped in the dust and crushed by the thundering ruins of the noblest piles of Copenhagen. Some doubtless see with grief their property destroyed—others in agony deplore the termination of all their earthly pleasures in the fate of their murdered friends. They are amazed that such horrific and atrocious scenes involve not the instant vengeance of heaven : but their wonder is vain—distraction seizes their bosoms—despair or the fate of their friends terminate the tremendous scene.

Thus then the capital of an ancient nation was surprized by the arms of a state in the strictest alliance with her ; a people who hailed us as friends, were robbed and plundered

by us; we stained ourselves with the blood of our firmest friends, and, by one act of unparalleled atrocity, Britain fell from her high and dignified rank among the nations.

But even in this atrocious crime, we discover proofs that it was unauthorized. For had the Danes had the slightest hostility to us, it would have been our duty, as Mr Ponsonby observed, to have retained possession of Zealand, or at least we ought to have dismantled the arsenal, destroyed the docks, blown up the Crown batteries and Cronberg Castle, and insured the quiet passage of the sound.—But it was because there was no ground for the attack, that atrocity itself shuddered to proceed further in the task of iniquity.

If, however, the present administration were destitute of genius, one would at least expect from them learning. They ought to have been aware of the famous maxim of Machiavelli* "that if injury be done to any nation, it ought to be of such magnitude as to take away the power of revenge." Their model Buonaparte would never have evacuated Zealand.

Can eighteen ships of the line compensate either in a moral or political point of view for such treachery and such disgrace!—Henceforth the very sailors who manned these ships are those of France by every natural tie; all the maritime states are interested in her cause, and even the inland nations demand satisfaction for Denmark. The act was therefore as impolitic as atrocious; for, at one blow, it irrecoverably destroyed the high character of Britain—the glorious work of immortal statesmen—the meed of distinguished honour and unshaken fidelity; it almost effaced the recollection of the lesser crimes of France, excited the cry of indignation and horror even from those who would willingly have been our allies, and left us to fight our own battles—perhaps to fall without one friend to deplore us.—For this, were not Britain, in spite of the crimes of her ministry, the only remaining bulwark of liberty and of science, even the warm philanthropist would be almost prompted to supplicate her punishment.

If, perchance, a Dane should see what I have just written, he will at once have a proof of the liberty of England, and the only poor apology which I can offer, in an assurance, that "the crimes of an administration are" *not*, in every sense, "the crimes of a people."

Thus far I agree and thus far differ from Mr Roscoe as to the grounds of the preceding warfare.

With regard to the present causes of war, I am far from

* Il Principe.

agreeing with him, that "they are removed by the treaty of Tilsit." Nay, I would even argue that, in spite of the conduct of Russia, we still contend for interests not our own—the interests of Europe, from which our own are inseparable and upon which the maintenance of our liberties, our constitution and our laws are, in no small degree, dependent. It is in vain that Mr Roscoe asks "at what period since the revolution in France, has the French government *proposed to us that we should relinquish or divest ourselves of any of these invaluable treasures!!!*" This question he cannot intend should be answered.

In short, we have at all times a right to embrace additional motives for our conduct even in the affairs of private life, but cannot, ought not to avoid doing so when, in war, accumulated motives are every day forced upon us by an unprincipled enemy.

The real cause of hostilities is, that the liberties of Britain are not by us, as Mr Roscoe asserts, but by France, brought to the hazard of the die; that Britain is, at this moment, threatened by France with the destruction of her political existence; and the government of that country, if we are to judge from her conduct to Italy, Holland, Spain, Germany, Portugal, even in the midst of peace, would certainly not have much more hesitation to send a hundred thousand men to England, than we ourselves had to send them a few months ago to Denmark. Now Denmark was, when surprised by us, precisely in that state in which we must be, if at peace, and, in such a case, there is not time to recommence war, as Mr Roscoe himself proposes, with the slightest hope of advantage.—Such a peace would be worse than ten thousand wars. We should soon be told by the tyrant to accept the reward of our own treachery.

By a short peace, Buonaparte would precisely obtain those acknowledgements for himself and his dependents, and acquire that consolidation of power, which could most successfully annoy us, and for which alone he has, at any time, been ready to make a peace. For he has to his confidants often declared that, "while one of the ancient states remains in Europe and particularly Britain, he, they and the principles by which they subsist are unsafe; that they are doubly unsafe from Britain, because she is not only formidable in herself, but, as experience has proved, wonderfully capable of at once exciting and aiding the rest; that therefore he was doubly bent upon, and had solemnly pledged himself to her ruin, nor should he conceive the subjugation of the continent as any thing but a step to that great purpose, which he never should rest till he had effected by peace or by war."

That the present object of the war is to prevent this by preventing France from forming a marine is perfectly correct. Nor do we possess any more effectual means.

But, from the object, we must proceed to the consequences of the war, because Mr Roscoe immediately introduces them as proofs of the inadequacy of that object. Remarks upon the one will consequently illustrate the other.

These consequences he considers to be chiefly of two kinds, namely, the exciting of rivalry in the French at sea, and the injuring of our commerce.

As to the first of these, there is, in Mr Roscoe's opinion, reason to apprehend, "that this conduct of ours, in blockading the ports of France, may excite the same spirit among her sailors, that similar conduct formerly did among her soldiers, and give rise to the very rivalship which we so greatly dread."

To this Mr Roscoe's own language, in another place, forms the best answer: "Apprehensions" he says, "it is true may be indulged to insanity; and they who have contemplated the astonishing atchievements of Buonaparte by land, seem to suppose that, when he gives his attention to naval affairs, he must instantly be successful. But, in the present situation of France, the cases are wholly dissimilar." In another place, he says, "were Buonaparte to attempt to deprive us of our maritime superiority, his efforts would be as vain as ours have been to overturn his power on the continent;" and, in a third place, "we may regard all the efforts of France to rival us as a maritime power, without dismay."...No answer of mine can be more complete than these.

I may, however, add, that it would indeed be difficult for France to cope with us at sea, while her ships are not permitted in any considerable number to leave their own ports, and and her sailors are thereby deprived of that practice which is necessary to give the slightest probability of success to their attempts in case even of accidental escape. Their struggle would be infinitely more vain with us than that of Russia ever appeared to me to be with France. For hostile discipline may form an enemy's army, because, on land, there is a field and room for successive retreat. But it is widely different at sea. There, a defeat is generally attended with entire destruction; and when the only alternative to destruction is keeping the port, submitting to be shut up, and so to be deprived of practice, the probable choice is evident.

The greatest of moral and political as well as of physical

philosophers, Lord Bacon *, says, "Thus much is certain, that he that commands the sea is at great liberty, and may take as much and as little of the war as he will.—To be master of the sea is an abridgment of a monarchy. Cicero, writing to Atticus, of Pompey's preparation against Cæsar, saith, 'Consilium Pompeii plane Themistocleum est; putat enim qui mare potitur, enim rerum potiri.' And without doubt Pompey had tired out Cæsar, if, upon vain confidence, he had not left that way.—The battle of Actium decided the empire of the world.—The battle of Lepanto arrested the greatness of the Turk."

As to our commercial interests, they have actually increased in prosperity with the continuance of the war.—False analogies in reasoning are the source of every error. Mr Roscoe thinks that an attempt to starve the continent, as he terms it, into the admission of our trade, is analogous to the attempt of the allies to starve France into submission at the commencement of the war, and likely to be as unsuccessful. But the difference is wide indeed. In that case, the attempt was, in the strictest sense of the word, to starve France, and nothing was offered to them in lieu of those things of which we endeavoured to deprive them. In the present case, no attempt is actually made to starve France; on the contrary, we offer to her subjects commodities of better manufacture and at a lower price than, from the inferior condition of the arts, and the military state of the continent, they can possibly elsewhere obtain. Nothing can be so opposite to the former scheme of starvation than the offering them all the articles of commerce for less money than they can even make them. Our attempt is precisely reducible to this, namely, the prevention of their obtaining them elsewhere at a higher rate. Hence, evidently, hostile exertion on our part would be unnecessary, were not the inclinations even of the French people opposed by the arbitrary measures of their government, who alone can be charged with an attempt to starve them. The most arbitrary measures, however, cannot effect the purpose, for men will surmount wonderful difficulties in order to obtain all those articles of commerce on the possession of which either natural or artificial habits have rendered their happiness in a great degree dependent. Fortunately for the French people, as well as for Britain, there are few or no difficulties in the way. The ships of Holland, and even of France, can enter an English as easily as a German port, nor is it possible for the spies of Buonaparte to identify British manufacture. When it is made the actual

* Essays Civil and Moral.

interest of a whole nation to deceive its governors, and when the utmost facility of doing so is inevitable, there can be no question as to the result. This result constitutes the best proof of what I have said. Our commodities are not offered in vain. The edicts of the tyrant may, for a moment, interrupt the particular channels of commerce, but they can serve only to disgust his own subjects. The greatest distress, and the loudest clamours, have frequently compelled him to relax the prohibitory commercial laws of Holland, and vessels even pass direct from the coast of France. Our ports are in reality filled with their vessels. To argue further upon this subject would be vain, for wherever the wants of mankind can be supplied at the cheapest rate, and in the best manner, it is in human nature to profit by it.

When Mr Roscoe states, on the other hand, that "the ratio of our increase in maritime commerce and maritime strength when at peace, must, independent of our present superiority, exceed that of France, in a degree proportioned to the superiority of our resources," he forgets that, if the ratio of our commerce in time of peace were to that of France as four to one, it is much more beyond the reach of rivalry if in war it be even as one to nothing. In one case, there is a ratio between them, in the other, none. The very reverse then, is the case, the ratio would actually be less in our favour in case of peace.—Mr Roscoe's assertion, that "whatever may be the language of Buonaparte with respect to ships, colonies and commerce, these are not the objects toward which his views will be directed !!!" need not be answered.

Having answered Mr Roscoe as to the present causes, objects and consequences of the war, I shall now endeavour to point out that error in reasoning upon which his partial views and erroneous conclusions depend. For this purpose, I recur to the second sentence of the pamphlet, because it actually involves this error of reasoning, exhibits the substance of his whole work, and admits of a more general answer than I have hitherto given.

"The experience of another year of warfare has been added to those which preceded it, and has shown, not only the futility of all attempts on our part to overturn or diminish the power of France, but the high probability that all such attempts will still continue to produce effects directly the reverse of those intended." Mr Roscoe's argument, therefore, amounts to this, that because we have been unsuccessful in the preceding part of the war, it is equally to be expected that we shall

be so in the succeeding, and therefore we ought to make peace.

Here Mr Roscoe commits the greatest error in reasoning —an error which would prove a person of less importance to be destitute of all profundity in political science, as well as ignorant of one of the most important principles of political philosophy; he also abandons that mode of investigation which can alone show how war may be successful, or peace honourable. Mr Roscoe forgets to inquire, "why these preceding years of warfare have aggrandized France and annihilated the nations of the continent?" Without answering this question, any conclusion from the previous war is totally unauthorized. No just one can be drawn from it. Mr Roscoe ought to know, that war in itself is not the cause either of success or of disaster. The force employed, and the genius by which that force is directed, can alone ensure the one, and enable us to avoid the other. All the triumphs of France, and all the misfortunes of Europe, have arisen from the neglect of this inquiry. It ought to have been, if not the chief, the first object of Mr Roscoe's work, which, from the neglect of it, is rendered useless.

This inquiry would have shown him, that it was the superior talent by which the troops of France were directed, that made her the mistress of the continent, and rendered the other nations her dependents. It would also have shown him, that military talent alone is insufficient to ensure the very objects of war—advantageous terms of peace, and that the skilful diplomatists of France, though she had the worst of the war, are capable of obtaining for her the best of the peace. They have more than once actually done so. With what advantage, then, must they negociate, when the military success of their country is unparallelled!—Had Mr Roscoe considered these things, instead of unqualifiedly inculcating either peace or war, he would have enforced the indispensible necessity on our part of employing equal talents, in order either to succeed in war or preserve ourselves in peace.

It is indeed strange, that the most scientific nation on the earth—a nation which has in it more of mind than all the other nations of Europe combined, should not be able to boast one General. It is indeed strange, that the countrymen of the greatest of politicians, Lord Bacon, who, on the subject of negociating, said, "If you would work upon any man, you must either know his nature and fashions, and so lead him; or his ends, and so persuade him; or his weaknesses and dis-

advantages, and so awe him; or those that have interest in him, and so govern him*," and who, I venture to assert it, has besides delivered in his works every valuable principle of diplomacy—it is strange indeed that they should not possess one Diplomatist. It affords the strongest proof of the disgraceful nature of our political and military arrangements.

Had Mr Roscoe considered these things, he would next have been led into the consideration whether peace or war were most likely to insure the preservation of our independence, and instead of the proposition, that "we have been unsuccessful in war, and therefore ought to make peace," he might, with perhaps greater propriety, have adopted the reverse, that "all those nations of the continent who have made peace with France have been annihilated, and Britain, who has alone persevered in war, has alone maintained her independence; therefore the continuance of the war is indispensible to her existence." I say this conclusion would have been at least equally legitimate. For it was in a period of peace that Italy was added to France, and that the independence of Genoa was annihilated; it was in a period of peace that the north of Germany was made tributary, and that a brother of the tyrant was placed upon the throne of Holland; it was likewise in a period of peace that his mercantile spies were sent to Britain as the prelude of her subjugation. I say this view would be more justifiable than that which Mr Roscoe has taken.

But, instead of implicitly adopting either of these methods, both of which involve an error in reasoning, and show neglect of the fundamental principles of political philosophy, he would have done well to inculcate the indispensible necessity of those political acquirements, of the neglect of which in Britain his work is the most convincing proof and the best specimen, and those military acquirements, the want of which is proved by every event of the war, and the possession of which would amply compensate for all the defects of the blockading system, and not only ensure the security but the superiority of Britain.

"If," says Mr Roscoe, "the war is to be continued, it is now no longer matter of exaggeration to assert, that the sovereign of these realms is to contend for his crown; the people for their liberties and rights; for the *soil in which their forefathers lie entombed;*" and asks, "Against this *stake* what is the prize we can hope to obtain from the enemy? Now

* Essays Civil and Moral.

Mr Roscoe ought to have known that this has long and avowedly been the grand object of the contest, and that though, as he very properly expresses it, "in a state of war Great Britain has (hitherto had) her equals, while in a state of peace she has none;" yet that Britain, although she has not hitherto been inferior, within her proper sphere, to France, must, in consequence of scientific improvement, soon be enabled to do what she has never attempted before.

Is Mr Roscoe ignorant that Britain is the sole remaining bulwark of the liberty of the world, and that while, by a state of avowed warfare, she declares her readiness to aid the nations of the continent in the recovery of their independence, the tyrant trembles on his throne?—Is Mr Roscoe sufficiently ignorant of human nature to suppose that these nations are not watching the most favourable opportunity of successful resistance; that Russia, Austria, Holland, Prussia, Switzerland, Italy and Spain are not rapidly acquiring those arts, by the former neglect of which they lost their independence; and that the interior of France is still less satisfied than the exterior? At this moment, the greatest men in France are prisoners in their houses, and wait only for that perfect accumulation of hatred which will not ultimately fail to hurl the puppet of Talleyrand and Berthier from that elevation which is itself an insult to every thing liberal in France. Among these, himself a host, the celebrated Carnot is honoured with a place. To this great geometer in military, and Sieyes in political affairs, Buonaparte is entirely indebted for his elevation. The former planned the campaigns in Italy, which obtained for him the rank of commander of the army of Egypt, and the latter recalled him from that country to take possession of the government of France. *In truth, that Buonaparte's chief recommendation was his popularity, is decidedly proved by this, that these great men, his directors, could not have assumed the very power they could so easily confer upon him.* This was precisely because they wanted his popularity. As he has discarded the first two, the other two also may tremble; their time will arrive. It was only necessary for Carnot to express the noblest and most patriotic of sentiments, in order to be immured during life; and we have no reason to conclude that Talleyrand, when he has served the purposes of the tyrant, will not meet a similar fate.* But it is also to be remembered, that the men who could elevate, can, at least, contribute to depress the tyrant; nor is it possible they should want the inclination. The day

* It is already reported that he has been disgraced.

is not distant when the Gallic Python will be slain. I never think of it that it does not bring to my recollection that of her ancient poets. Like it, it seems to have risen from the filth and slime that a deluge—the wreck of a world, has left behind it, and, like it, the genial warmth of the sun, the evaporation of the marshes—the regular operations of nature will infallibly destroy it. When the French system does fall, it is probable that it will fall with wondrous velocity. I have sometimes in imagination amused myself with its appearance, and the person who in a pantomime has seen an ephemeral fabric, by one touch of the magic wand, hurl to the ground, with a rapidity that defied the possibility of distinguishing whether the middle or the top of it first reached the earth, has in my mind a just conception of the scene.

The sentiment which I have just described pervades the whole of France, which, though equally subjugated, is not more contented than the contiguous nations. This can subsist but for a period, if Britain maintain a *scientific* warfare.

LIBRARY

LIST OF NEW PUBLICATIONS.

TOPOGRAPHY.

A History of Brecknockshire, by Theophilus Jones, deputy registrar of the Arch deaconry of Brecon, 3 vols royal 4to. with numerous Plates. 7l. 9s. 6d.

The Cambrian Traveller's Guide, 8vo. 7s. 6d.

.....

ARTS AND SCIENCES.

An Alphabetical List of the names of Minerals at present most familiar, in the English, French, and German Languages, with Tables of Analyses. 5s.

Outlines of an Attempt to establish a Knowledge of Extraneous Fossils, on Scientific Principles; by William Martin. F. L. S. 8vo. 8s.

The Retrospect of Philosophical, Mechanical, Chemical, and Agricultural Papers, published by Philosophical Societies, and in the various English and Foreign Periodical Works, No. XVII. 8s. 6d.

A complete System of Geography, Ancient and Modern; by James Playfair, D. D. Vol. II. 4to. 2l. 2s.

Metaphysical Essays, containing the Principles and Fundamental Objects of that Science, with some Considerations upon the Human Mind, &c. by Richard Kirwan, L.L.D. F.R.S. 8vo. 12s.

An Essay on the various Orders of Logarithmic Transcendants, with an Inquiry into their Applications to the Integral Calculus, and the Summation of Series; by William Spence, 4to. 12s.

A Treatise on the Properties of Arches, and their Abutment Piers; by Samuel Ware, architect. 1s. 6d.

Asiatic Researches, Vol. IX. 8vo. 12s. —4to. 1l. 5s.

An Essay on the Various Orders of Logarithmic Transcendants; with an Inquiry into their Application to the Integral Calculus, and the Summation of Series, 4to. 12s.

The New Encyclopædia: by William Enfield, M.A. Vol. I. containing Astronomy. 4s. 6d.

Pinkerton's New Modern Atlas, containing Maps of France, the West Indies, and Japan, No. I. 1l. 1s.

The Retrospect of Philosophical, Mechanical, Chemical, and Agricultural Discoveries, No. XVIII. 3s. 6d.

Abridgement of the Philosophical Transactions from their Commencement in 1665, to 1800; by Drs Hutton, Shaw, and Pearson, 18 vols. 4to. 38l. 6s. 6d. boards; large paper 65l. 14s.

The Bricklayers Guide to the Mensuration of all sorts of Brick-work; by J. W. Dearn, 8vo. 7s.

Memoirs of British Quadrupeds; by the Rev. G. Ringley, Vol. I. 8vo. 18s. large paper 1l. 15s.

.....

FINE ARTS.

Greek Marbles, brought from the Shores of the Euxine, Archipelago, and Mediterranean, and deposited in the Vestibule of the University Library, Cambridge: by Edward Daniel Clark, L.L.D. 5s. Large paper, 10s. 6d.

The Historic Gallery of Portraits and Paintings: containing Raphael's Cartoons complete, and analogical Frontispiece. No. XXV. 4to. 7s. 6d.

Ornamental Groups, descriptive of Flowers, Birds, Shells, and Insects. By M. Gartside, No. II. imperial folio. 2l. 2s.

An Engraving, by Heath, from a picture of the late Mr Russel, of William Wilberforce, esq. M.P. 1l. 1s.

Hassell's Weekly Drawing Magazine of Rural Scenery, No I. (to be continued weekly) 6d.

An Historical Survey of the Ecclesiastical Antiquities of France, with a view to illustrate the Rise and Progress of Gothic Architecture in Europe. By the late Rev. G. D. Wittington; royal 4to. 1l. 6s.

The British Gallery of Portraits, No. I. atlas quarto, 1l. 5s. imperial folio 1l. 16s.

A Set of Plates to illustrate the Scripture History; designed by Mr Craig, and cut in Wood, by Bewick, Nesbit, Branston, Clennel, and Hole. Ninety-nine Subjects, printed in demy quarto, 16s. royal ditto, 1l. 5s. ditto, on Chinese Paper, 1l. 11s. 6d. ditto, imperial quarto ditto, 1l. 15s.—Eighty-one Subjects,

demy octavo, 10s. 6d. royal ditto, 1l. 15s. on India paper, 1l.

The Historic Gallery of Paintings and Portraits; containing correct Copies, in Outline, of the Works of the most celebrated Painters; with Critical Remarks and a Biographical Memoir, 4 vols. 8vo. 4l. 16s. large paper 9l.

The Thames: or, Graphic Illustrations of Seats, Villas, Public Buildings, and Picturesque Scenery, on the Banks of that Noble River. Engraved by William Cooke, from Original Drawings, by Samuel Owen, esq. No. I. 4s. 6d.

.....

DRAMA.

Pœtus and Arria, a Tragedy; with a Letter to Thomas Sheridan, esq. on the present State of the English Stage. 2s. 6d.

Three Comedies, translated from the Spanish—1. The Fair Lady, from La Dama Duende, by Don Pedro Calderon de la Barea—2. Keep your own Secrets, from Nadie Fil su Secreto, by the same. —3. One Fool makes many, from Un Bobo Hace Ciento; by Don Antonio de Solis. 8vo. 7s. 6d.

Grieving's a Folly, a Comedy, in Five Acts. By Richard Leigh, esq. 2s. 6d.

Panthea, Queen of Susa, a Tragedy, in Five Acts. 2s. 6d.

The Meteor, or a Short Blaze but a Bright One, a Farce, in Two Acts. By J. B. Gent, 2s.

.....

POETRY.

A Translation from the Latin of Vanier. Book XV. upon Fish; by the late Rev. John Duncombe, of Christ Church College, Cambridge: with a brief Introduction and Passages from English Writers, selected as Notes.

An Elegiac Tribute to the Memory of our much-lamented Hero Sir John Moore; by Mrs Cockle. 2s.

The Muses Bower, embellished with the Beauties of English Poetry. 4 vols. small 8vo. 1l. 4s.

Europes Lines on the present War; by Reginald Heber, A.M. 2s.

English Bards and Scottish Reviewers a Satire, with Notes. 4s.

Latin and English Poems, Translations, &c. by the Rev. Richard Barnett. 8vo. 8s.

The Holidays, or Application Rewarded, and Indolence Disgraced. 1s.

Military Promotions, or the Duke and his Dulcinea; a Satirical Poem. 2s. 6d.

Royal Love Lyrics, from Royal Love Letters, with Notes and Illustrations. 2s. 6d.

Rudigar, the Dane; a Legendary Tale; by Eaglesfield Smith, esq. 2s.

The Iliad of Homer, translated into English Blank Verse; by the Rev. Jas Morrice, A. M. rector of Bethanger, Kent; and vicar of Flower, Northamptonshire, 2 vols. 8vo. 1l. 1s.

Sonnets of the Eighteenth Century, and other small Poems, Foolsc. 8vo. 5s.

The Thespiad; a Poetical Critique on the Principal Theatrical Performers. 2s. 6d.

Horæ Ionicæ, descriptive of the Ionian Islands, and the adjacent Coast of Greece; by Waller Rodwell Wright, esq. some time his Majesty's Consul General for the Republic of the Seven Islands, 8vo. 4s.

Gertrude of Wyoming, or the Pensylvanian Cottage, and other Poems; by Thomas Campbell, 4to. 1l. 5s.

The Four Slaves of Cythera; a Romance, in ten Cantos; by the Rev. Robert Bland, 8vo. 9s.

The Bibliomania, an Epistle to Richard Heber, esq. by John Ferriar, M. D.

Poems, sacred to Love and Beauty; by Hugh Downman, M. D. 2 vols. 10s. 6d.

Poemata Selecta Italorum, qui seculo decimo sexto scripserunt, nonnullis annotationibus illustrata. 10s. 6d.

Lady Jone Grey, a Tale, with Miscellaneous Poems in English and Latin. By Francis Hodgson, esq. 8vo.

The Cyprian of St Stephens, or princely Protection illustrated. By Samuel Satiricus, 4to. 3s.

Poems by the Rev. W. Lisle Bowles, vol. IV. 8s.

Palestine, a poem recited in the theatre, Oxford; to which is added, the Passage of the Red Sea, a fragment. By Reginald Heber, 4to. 12s. 6d.

Kennet and Kennela, a Legendary Tale. By the Rev. T. S. Whalley, D. D. 2s. 6d.

Les Forts Britanniques. Poeme Historique; formant un Precis de l'Histoire de la Grande Bretagne, depuis l'Invasion de Jules Cæsar jusqu'a la Rupture des dernieres Negociations entre la France et l'Angleterre. Par Mons. Le Noir. 8vo. 12s

.....

MUSIC.

The Flowers of Harmony, being a selection of the most celebrated catches, glees, and duets. No. II. 1s. 6d.

.....

NOVELS AND ROMANCES.

John de Lancaster; by Richard Cumberland, esq. 3 vols. post 8vo. 1l. 1s.

The Soldier's Orphan; by Mr Costello, 3 vols. 12mo. 13s. 6d.

The Dominican, a Romance, of which the principal Traits are taken from the Events relating to a Family of Distinction, which emigrated from France during the Revolution, 3 vols. 12mo. 15s.

The Cottage of Merlin Vale; a History founded on Facts. 2 vols. 12mo. 10s.

The English Brothers, or Anecdotes of the Howard Family, 4 vols. 12mo. 1l. 1s.

Levity and Sorrow. a German Story; by M. A. Bianchi, 2 vols. 12mo. 10s.

Laughton Priory; by Gabrielli, 4 vols. 12mo. 1l.

The Irish Guardian, or Errors of Eccentricity; by Mrs Mackenzie, 3 vols. 12mo. 15s.

Susan, 2 vols. 12mo. 8s.

Hours of Affluence and Days of Indigence; by Miss Byron, 4 vols. 12mo. 1l.

Lucky Escapes, or Systematic Villainy, 3 vols. 12mo. 15s.

The Family of Santraile, or the Heir of Montault. By Harriett Jones, 4 vols. 1l. 14s.

The Letters of a Peruvian Princess, by Madame de Grafigney, and the Letters of Aza, by Ignatius Hungari de la Marche Courmont. Translated from the French by William Mudford, foolscap 8vo. 6s.

The Beggar and his Benefactor. By Miss C. Squire, foolscap 8vo. 5s.

Monte Video, or the Officer's Wife and Sister, 4 vols. 18s.

Emily, a Moral Tale. By the Rev. Harry Kett, 2 vols. 8vo. 14s.

Malilda, and Malek Adhel, from the French of Madame Cottin, 4 vols. 1l.

.....

BIOGRAPHY.

Authentic Memoirs of Mrs Mary Ann Clarke; by Miss Taylor, small 8vo. 6s.

Memoirs of the Rev. Samuel Bourn, many years one of the Pastors of the United Congregation of the New Meeting in Birmingham; by Joshua Toulmin, D.D. 8vo. 7s,

The Authentic and Impartial Life of Mrs Mary Ann Clarke; by W. Clarke, esq. foolscap 8vo. 3s. 6d.

Authentic and Interesting Memoirs of Mrs Clarke, from her Infancy to the present Time; likewise a faithful Account of Mr Wardle's Charges relative to his Royal Highness the Duke of York, and the Minutes of Evidence complete. 12s.

Memoirs of the Life and Writings of Percival Stockdale, containing many interesting Anecdotes of the illustrious Men with whom he was connected. 2 vols. 8vo. 1l. 1s.

The Life of Alexander Nowell, Dean of St Paul's. By Ralph Churton, M.A. 8vo. 1l. 1s.

.....

HISTORY.

A Cursory View of Prussia, from the Death of Frederick II. to the Peace of Tilsit; containing an authentic Account of the Battles of Jena, Auerstadt, Eylau, and Friedland, as also other important Events during that interesting Period. In a Series of Letters. 5s.

The History of Don Francisco de Miranda's Attempt to effect a Revolution in South America. In a Series of Letters; by James Bigg. To which are added, Sketches of the Life of Miranda, and Geographical Notices of the Caraccas, 8vo. 7s. 6d.

Observations on the Historical Work of the late Right Hon. C. J. Fox. By the Right Hon. G. Rose. With a Narrative of the Events which occurred in the Enterprise of the Earl of Argyle in 1685. By Sir Patrick Hume. 1l. 5s.

.....

POLITICS.

A Letter to Mrs Clarke, on her late Connection with the Duke of York, and the Charges brought against his Royal Highness in the House of Commons, by G. L. Wardle, esq. 3s.

The Investigation of the Charges brought against his Royal Highness the Duke of York, by G. L. Wardle, esq. M. P. for Oakhampton, Devon; with the Evidence at large, and the Remarks of the Members. In Numbers, 12mo. 6d. each.

A Summary Review of the Charges adduced against his Royal Highness the Duke of York. 1s.

A Circumstantial Report of the Evidence and Proceedings upon the Charges preferred against his Royal Highness the Duke of York, in the capacity of Commander-in-chief, by G. L. Wardle, esq. M. P. before the Honourable House of Commons: with Portraits, 8vo. 12s. 6d.

An heroic Epistle to G. L. Wardle,

esq. on his Charges preferred against his Royal Highness the Duke of York. 2s. 6d.

Observations on the Conduct of Mrs Clark: by a Lady. 2s. 6d.

A correct and Authentic Copy of the Evidence taken before the House of Commons on the Charges exhibited against his Royal Highness the Duke of York; in which are included several Documents that have not yet appeared before the public, copied verbatim from the Minutes of the House, 8vo, 12s.

The Reign of Cytherea, a Defence of his Royal Highness the Duke of York.

An attempt to elucidate the pernicious Consequences of a Deviation from the Principles of the Orders in Council. 2s. 6d.

State of the Foreign Affairs of Great Britain for the Year 1809; by Gould Francis Leckie, esq. 2s.

A Letter to the Right Honourable Lord Henry Petty, by a Member of the University of Cambridge. 2s.

Hints to both Parties, or observations on the Proceedings in Parliament, upon the Petitions against the Orders in Council, &c. 2s. 6d.

A Memoir on the Affairs of Spain. 1s. 6d.

Debates in both Houses of Parliament on the Catholic Petition, on Wednesday the 25th, and Friday the 27th of May, 1808, 8vo. 5s.

The Corrected Speeches of Mr Wardle, the Chancellor of the Exchequer, Mr Whitbread, Mr Adam, Sir Francis Burdett, Mr Croker, Sir Samuel Romilly, Mr Wilberforce, Lord Folkstone, Mr York, Mr Canning, &c. in the House of Commons, on Mr Wardle's Charges against his Royal Highness the Duke of York, 8vo.

Memoirs of the King's Supremacy and of the Rise, Progress, and Results of the Supremacy of the Pope, in different Ages and Nations, as far as relates to civil Affairs; by Thomas Brooke Clarke, D. D. 8vo. 10s. 6d.

The Orders in Council, and the American Embargo, beneficial to the Political and Commercial Interests of Great Britain; by Lord Sheffield, 8vo. 2s.

A Correct Report of the Speech delivered by Sir Francis Burdett, bart. in the House of Commons, on Monday the 13th of March, 1809, on the conduct of the Duke of York. 1s.

A View of the Political Situation of the Province of Upper Canada, in which her physical Capacity is stated; the Means of diminishing her Burdens, increasing her Value, and securing her Connection with Great Britain, are fully considered; by John Mills Jackson. 3s.

Certain Accusations brought recently by Irish Papists, against British and Irish Protestants of every denomination, examined: by Thomas Kipling, D. D. Dean of Peterborough. 3s.

Reflections on the Appointment of Dr Milner, as the Political Agent of the Roman Catholic Clergy of Ireland; by the Rev. Thomas Elrington, D. D. 1s. 6d.

An Address to the People of England, on the absolute necessity of a Reform in Parliament. To which are annexed, complete copies of Magna Charta, and the Bill of Rights, 2s. 6d.

An Account of the Proceedings of the Inhabitants of Southwark, at their town-hall, April 12. 1809, on their vote of thanks to Mr Wardle, with an Address to the Electors on Reform of Parliament. By Mr Favell.

A Letter to the Right Hon. the Lord Mayor of London, on the subject of Common Halls and County Meetings, with a few Hints on Parliamentary Reform, 2s.

A Full Report of the Proceedings of the Electors of Westminster, on Wednesday, March 29. 1909, at a meeting held in Westminster-hall, to express their sentiments on the Inquiry into the conduct of the Duke of York, 1s.

A Letter to Samuel Whitbread, esq. upon the late Inquiry, the Destruction of Important Papers, and Parliamentary Reform, 1s.

The Dangers of British India, from French Invasion and Missionary Establishments. By David Hopkins, of the Bengal medical establishment, 7s.

The Speech of James Stephen, esq. in the House of Commons, March 6. 1809, on Mr Whitbread's motion, relative to the late Overtures of the American government, 3s. 6d.

A Correct Copy of the Speech of the Chancellor of the Exchequer, in the debate on the Inquiry into the Conduct of the Duke of York, 3s. 6d.

Thoughts on the Present State of our Domestic Affairs, shewing the necessity of an Administration formed on the basis of an Union of Parties, 2s. 6d

Summary Review of the Evidence against the Duke of York, 1s.

Observations on the National Debt, with a Plan for Discharging it, so as to do complete justice to the equitable claims of the stock-holder, and be at the same time highly advantageous to the nation at large, 3s.

Elements of Reform, or Account of the Motives of the Advocates for Parliamentary Reformation. By William Cobbett, 2s.

AGRICULTURE.

Observations on the Utility, Form, and Management of Water Meadows, for Draining and Irrigating Peat Bogs; by William Smith, Engineer, 8vo. 8s.

The Farmer's Magazine, No. xxxvii.

The Utility of Agricultural Knowledge; illustrated with an account of an Institution formed for Agricultural Pupils in Oxfordshire. 1s. 6d.

The Manures most advantageously applicable to the various sorts of Soils, and the Causes of their Beneficial Effect in each patticular instance; by Richard Kirwan, esq. foolscap 8vo. 2s.

.....

MILITARY.

Rules and Instructions for the Guidance of Officers and Non-commissioned Officers in the Field, and on other occasions, respecting the Use and Management of Guns, &c. under their charge. or to which they may be attached; particularly adapted to the Service of the East Indies; by Lieutenant Colonel Robert Bell, Commandant of the Artillery on the Madras Establishment. 6s.

Manœuvres of Horse Artillery; by General Kosciusko: written at Paris in 1800, at the Request of General W. R. Davie, then Envoy from the United States to France. Translated, with Notes, by J. Williams, Colonel Commandant of the Corps of Engineers, and the President of the United States Military Philosophical Society. With 18 plates. 6s.

Operations of the British Army in Spain, with broad Hints to the Commissariat and Transport Board. and Anecdotes illustrative of the real Spanish Character. 3s.

A Narrative of the Circumstances attending the Retreat of the British Army, under the command of the late Lieut. Gen. Sir J. Moore, with a concise Account of the Battle of Corunna, and subsequent Embarkation of his Majesty's Troops; by Henry Milburne, Surgeon in the Spanish Service. 4s.

Proceedings of a General Court Martial held at the Horse Guards, on the 25th and 27th of March, 1792, for the Trial of Captain Powel, Lientenant Seton, and Lieutenant Hall, of the 54th regiment, on several charges preferred against them by William Cobbett, late serjeant-major. 2s 6d.

Observations on some of the most important Parts of the Art of War, as applicable to the present state of Tactics in Europe. By John Gourlay, esq. 2s.

.....

MEDICINE AND SURGERY.

Observations on some of the most important Diseases of the Heart; on Aneurism of the Thoracic Aorta; Preternatural Pulsation in the Epigastric Region; and on the unusual Origin and Distribution of some of the large Arteries of the Human Body. Illustrated by Cases; by Allan Burns, Member of the Royal College of Surgeons, London, and Lecturer on Anatomy and Surgery, Glasgow.

Cases and Observations on Lithotomy, including Hints for the more ready and safe performance of the Operation. With an Engraving. To which are added, Observations on the Chimney Sweepers' Cancer, and other Miscellaneous Remarks; by W. Simmons, Surgeon. 7s. 6d.

Anatomica-chirurgical Views of the Nose, Mouth, Larynx, and Fauces: with appropriate Explanations and References; by John James, Surgeon, folio. 1l. 11s 6d. plain, or 2l. 2s. coloured.

The Edinburgh Medical and Surgical Journal—No. XVIII. 8vo. 3s.

A short Treatise on the Virtues of Dr Gordon's Vegetable Balsamic Pills. 1s.

Suggestions for the Prevention of the Yellow Fever. To which is added, the Outline of a Plan of Military Hospitals, tending to a more successful Treatment of the Sick; by Stewart Henderson, M. D. District Staff Surgeon. Royal 8vo. 5s.

A Dictionary of Practical Surgery: by Samuel Cooper, Member of the Royal College of Surgeons in London. 8vo. 15s.

A Practical Materia Medica, in which the various Articles are fully described, and divided into Classes and Orders, according to their Effects, 12mo. 5s.

The Annual Medical Register, comprising a Review of every publication relating to Medicine and Surgery which

appeared in 1808; with a Sketch of the Discoveries and Improvements in those Sciences, &c. By a Society of Physicians, 8vo. 9s.

A System of Operative Surgery, founded on the basis of Anatomy. By Charles Bell, vol. 2. royal 8vo. 16s.

An Inquiry into the Symptoms and Treatment of Carditis, or the inflammation of the Heart, Illustrated by Cases and Dissections. By John Ford Davis, M.D. 12mo. 6s.

Thomæ Simsoni Medicinæ Professoris Candossensis in Academia Andreana, apud Scotos, De Re Medica, dissertationes quatuor. In usum Medecinæ et Humanitatis Studiosorum iterum excudi curabat Andreas Duncan, senior, M.D. et P. Principis Scotiæ Medicus Primarius. 7s. 6d.

.....

EDUCATION.

Latin Synonyms, with their different Significations and Examples, taken from the best Authors: by J. B. Gardin Dumesnel, late Professor of the University of Paris; translated into English, with Additions and Corrections, by the Rev. J. M. Gosset, 8vo. 15s.

The French Student's Vade Mecum; by the Rev. P. C, Le Vasseur, a native of France. To Subscribers, 5s. Non-Subscribers, 7s. 6d.

The Hebrew Reader, or a Practical Introduction to the Reading of the Hebrew Scriptures, for the use of Learners who were not taught Hebrew at Schools, and of Schools where it has not been introduced; by the Bishop of St. David's. 8vo. 2s.

The Hebrew Reader, Part II. containing Hebrew Extracts from the Bible. 8vo. 3s.

Copper-plate Copies of Hebrew Letters and Words, designed as a Companion to the above. 1s.

Letters on Ancient History, exhibiting a Summary View of the History, Geography, Manners and Customs of the Assyrian, Babylonian, Median, Persian, Egyptian, Israelitish, and Grecian Nations. By Miss Wilson, 8vo. 10s. 6d.

A Collection of Scripture Sentences for Committing to Memory. Selected by C. E. Richardson, 18mo. 2s. 6d.

The Practical Surveyor, being a Treatise on Surveying, designed for the Use of Schools. By the Rev. J. Furnass, 8vo. 10s. 6d.

An Introduction to Argus's Vocabulary, and Fulton's Dictionary, with Lessons for Reading, Spelling, &c. By William Angus. 9d.

An Introduction to the Epistolary Style of the French; or, a Selection of Familiar Notes and Letters, in French. For the Use of Schools. With an Alphabetical Index, explanatory of the Words and Idiomatical Expressions. By George Saulez. 1s. 6d.

The Elements of English Education. Intended for the Improvement of Youth of both Sexes, with Maps and Wood Cuts, &c. By John Brown, 12mo. 5s.

Excercises in Religious Knowledge; for the Instructions of Young Persons By Mrs Elizabeth Hamilton. 2s.

An Orthoepical Analysis of the English Language; or, an Essay on the Nature of its Simple and Combined Sounds: the Manner of their formation by the vocal organs; the Minute Varieties which constitute a Depraved or Provincial Pronounciation: and the Inadequacy of Attempting to explain them by Means of the English Alphabet. By T. Batchelor, 8vo. 7s.

Le Cadeau du Premier Jour de l'an, ou Historiettea et Conversations à l'usage des Jeunes Gens de l'un et de l'autre Sexe, et des Ecoles. Avec des Figures. Par Madame de G—— 18mo. 3s. 6d.

Le Guide des Enfans, ou Portefeuille de Morale. Dédié à la Jeunesse Angloise de l'un et de l'autre Sexe. Avec des Figures. 18mo. 3s. 6d.

Grammaire de la Langue Italienne, par Cajetan Polidori, Natif de Toscane. 8vo. 5s.

.....

LAW.

A Treatise on the Defects of the Debtor and Creditor Laws, and the Consequences of Imprisonment for Civil Debt; by W Menchen, esq. 5s.

Reports of Cases in the High Court of Chancery; by F. Vesey, jun. esq. of Lincoln's-inn, Barrister-at-law, vol. XIV. part II. 7s. 6d.

A most interesting Case, in a Letter addressed to Sir Samuel Romilly on the Bankrupt Laws; by George Baillie, esq. 1s.

The Law and Practice of Patents for Inventions: by William Hands, gent. one of the Solicitors of the Court of Chancery. 8vo. 5s.

Law Selections; containing distinct and familiar Treatises on such Divisions of the Law as are of most general Use and Importance; by James Barry Bird, esq. 2 vols. 8vo. 1l. 2s.

Trial of the Cause of Lord Dormer *v.* Robert Knight, esq. in the Court of Common Pleas, Guildhall, by a Special Jury, before the Right Hon. Lord Chief Justice Mansfield, Dec. 23, 1808. 3s.

Remarks on the Judicial Proceedings of our Courts, with a few modest Hints for the Amelioration of our Judicial Procedure; by Hugh Leslie, A.M. 1s.

A succinct View of the Law of Mortgages, with an Appendix, containing a Variety of Scientific Precedents of Mortgages; by Edward Coke Wilmot, of Gray's-inn. 6s.

Reports of Cases in Chancery; by T. Vesey, esq. of Lincoln's-inn, Vol. XIV. Part II. 7s. 6d.

A Treatise on the Defects of the Debtor and Creditor Laws, and the Consequences of Imprisonment for Civil Debts; by W. Minchin, esq.

Nightingale *versus* Stockdale—Report of the Trial in an Action for a Libel, contained in a Review of the "Portraiture of Methodism;" tried at Guildhall, before the Right Hon. Lord Ellenborough, and a Special Jury, Saturday, March 11, 1809. Taken in short-hand by Mr Bartrum. 2s. 6d.

Reports of Cases, Argued and Ruled at Nisi Prius, in the Courts of King's Bench and Bommon Pleas, and on the Home Circuit, in Trinity and Michaelmas Terms, 48, 49. George III. 1808, with Indexes, completing the first vol. By John Campbell, esq. vol 1. Part 3. 7s. 6d.

An Abridgement of the Law of Nisi Prius. By William Selwyn, esq. Part 3 and last. 10s. 6d.

.....

TRAVELS.

Summer Excursions through parts of England and Wales; by Elizabeth Isabella Spence, 2 vols. 12mo. 10s. 6d.

A Tour through Cornwall, in the Autumn of 1808; by the Rev. Richard Warner. 9s.

MISCELLANEOUS.

Strictures on Dr Milner's Tour, and on Mr Clinchs' Inquiry, with a new Plan for obtaining Emancipation for the Catholic's of Ireland. Humbly submitted to their Friends in Parliament; by the Rev. Edward Ryan, D.D. 2s 6d.

The Dangers of the Edinburgh Review, or a brief Exposure of its Principles in Religion, Morals, and Politics. In Three Letters addressed to its Readers; by Mentor, 1s. 6d.

The New London Review; conducted by Richard Cumberland, esq. No. I. 5s.

A new and original Comedy in Three Acts, called Valentine's Day, or the Amorous Knight, and the Belle Widow; by Anonymous. 3s. 6d.

The Quarterly Review, No. I. 5s.

State of the Foreign Affairs of Great Britain, for the Year 1809. 2s.

Political, Commercial, and Statistical Sketches of the Spanish Empire in both Indies. 4s. 6d.

An Analysis of Country Dancing, wherein are displayed all the Figures ever used in Country Dances, in an easy and familiar manner: to which are added, Instructions for Dancing some entire New Reels; together with the complete Etiquette of the Ball-room; by T. Wilson, from the King's Theatre, Opera House. 7s.

The Treasures of Terpsichore; or, a Companion for the Ball-room: being a Collection of all the most popular English Country Dances, arranged alphabetically, with proper Figures adapted to each Dance: together with the New Dances for 1809—by T. Wilson, Dancing Master, from the King's Theatre, Opera House. 4s. 6d.

A List of the Duties payable after Oct. 10. 1808, under the Management of the Stamp Commissioners in Great Britain. 4s.

The Spirit of the Public Journals for 1808. 7s.

London Characters, or Anecdotes of Fashions and Customs of the present Century; by Sir Barnaby Sketchwell. 2 vols. royal 12mo. 16s.

The Ecclesiastical and University Annual Register for 1808, 8vo. 16s.

Observations on the Impolicy of encouraging Ship-building in India, with Remarks on its ruinous Consequences to the Landed, Shipping, and Manufacturing Interest of Great Britain, 8vo. 5s.

Lettres et Pensées du Marechal Prince de Ligne, publiées par Madame de Stael, contenant des Anecdotes secretes sur Joseph II. Catherine II. Frederic le Grand, Rousseau, Voltaire, &c.. 2 vols. 12mo. 10s.

A Letter to the Young Gentlemen who write in the Edinburgh Review; by Senex. 1s. 6d.

A Catalogue of Books composing the Classical Library of W. H. Lunn, Soho-square. 3s.

Literary Miscellanies; by James Mason, esq. 2 vols. 8vo. 1l. 5s.

Thoughts and Remarks on establishing an Institution for the Support and Education of Unportioned Respectable Females. 7s.

The Livery Triumphant, a Letter to the Lord Mayor on his Conduct at the late Common Hall; to which are subjoined, the Proceedings and Speeches on that Occasion. 1s.

Green Room Gossip, or Gravity Gallipint. A Gallimaufry; by Gridiron Gabble, gent. 3s. 6d.

Claims of Mr Wardle to the Thanks of the Country, for his Parliamentary Conduct, in his Charges against the Duke of York. 2s.

A serious Admonition to his Royal Highness the Duke of York, on the evil Tendency of Corrupt Communication. 1s. 6d.

Freemason's Lectures, containing every Question and Answer as worked in our Lodges. 10s. 6d.

An Answer to the Challenge given by W. Blair, esq. A. M. and published in Dr Rees' Cyclopedia, respecting a Cypher of his own Inuention, which is absolutely inscrutable without the Key: by M. Gage. 10s. 6d.

Political, Commercial, and Statistical Sketches of the Spanish Empire, in both Indies. 4s. 6d.

The New Annual Register, for 1808. 8vo. 1l.

The Spirit of English Wit, small 8vo. 5s.

Mr Thelwall's Plan and Terms of Instruction to Domestic and Private Pupils. 5s.

Vindiciæ Satiricæ; or, a Vindication of the Principles of the Satirist, and the Conduct of its Proprietors; by G. Manners, esq. 2s. 6d.

Observations on the Conduct of Mrs Clarke; by a Lady. 2s. 6d.

The Lark, a Satire, without Notes. 2s. 6d.

A New Dormant and Extinct Peerage of England. By T. C. Bancks, vol. 3, 4to. 2l. 2s.

Letters and Reflections of the Prince de Ligne; containing Original Anecdotes of Joseph II. Catharine II, Frederic the Great, Rousseau, Voltaire, &c. Translated from the French of the Baroness de Stael Holstein. By N. Boileau, esq. 2 vols 12mo. 9s.

The Travels of Humanus to the Temple of Hoppiness, an Allegory. By William Lucas, 12mo. 6s.

Critical Observations on Books, ancient and modern. NO. XIV. 2s. 6d.

A Descriptive Catalogue of the Oriental Library of the late Tippoo Sultan, of Mysore. To which are prefixed, Memoirs of Hyder Ali Khan, and Tippoo. By Charles Stewart, esq. late major of the Bengal establiahment, 4to. 1l. 4s.

The Gentleman's Veterinary Monitor and Stable Guide; a concise Treatise on the Diseases and Management of Horses. By Yorick Wilson, royal 18mo. 3s. 6d.

Letters of Lady Rachel Russell, from the manuscript of the Library in Woburn Abbey; to which are prefixed, an Introduction, vindicating the character of Lord Russell, and his trial for high treason, extracted from the State Trials, 8vo. 10s. 6d. large paper, 13s.

Observations on the Golden Lane Brewery Bill, now before Parlihment, submitted to the consideration of the members of both Houses, 1s.

A Tract, chiefly relative to Monastic Antiquities; with some Account of a recent Search for the Remains of the Scottish Kings interred in the abbey of Dunfermline. By John Graham Dalyell, esq. 8vo. 9s.

Strictures on the Present State of Eloquence at the English Bar, with a few Hints to Jurors and Witnesses. In a Letter to Wm. Garrow, esq. By Tom Nugent, the money-lender, 1s.

A Letter addressed to Robert Hawker, D. D. vicar of Charles, Plymouth, su4gested by his Defence of the London Female Penitentiary, recently established in the vicinity of Islington. By John Evans, A. M. 1s. 6d.

Opinion delivered by Dr Duncan, sen. in the College of Physicians of Edinburgh, on the 13th of September 1808, upon a Charge against Dr Gregory, for wilful and deliberate violation of Truth. 2s. 6d.

The Librarian, containing an Account of scarce, valuable, and useful Books; by James Savage. Vol. I. 8vo. 6s. 6d.

THEOLOGY.

A Sermon Preached in the parish Church of Stillorgan, on Sunday October 30, 1808, at the request of the Stillorgan Charitable Institution for promoting the Comfort of the Poor; by the Rev. Robert Dealtry, L.L.D. Prebendary of Wicklow. 1s. 6d.

Sermons by the Rev. Sidney Smith. Two vols. 18s.

The Alexandrian School, or a Narrative of the first Christian Professors in Alexandria, with Observations on the Influence they still maintain over the established Church; by M. Jerninghan.

Hewlett's Bible, Part III. Royal 4to. 9s. demy 7s.

The Grounds on which the Church of England separated from the Church of Rome, reconsidered, in a View of the Romish Doctrine of the Eucharist; with an Explanation of the Antepenultimate Answer in the Church Catechism; by Shute, Bishop of Durham. 1s.

Treatises on the Seventy Years Captivity of the Jews, foretold by Jeremiah, and particularly on the Seventy Weeks Prophecy of Danial; by the Rev. J. Thorold. 2s.

A Letter from a Country Clergyman to his Parishioners, in which are considered a few of the Arguments and Practices of some of the Modern Dissenters: by the Rev. John Nance. 1s.

Hewlett's Bible, Part IV. 7s. (large paper, 9s.)

Paganism and Christianity Compared. In a Course of Lectures to the King's Scholars, at Westminster, in the years 1806, 7 and 8; by John Ireland. D.D. Prebendary and Subdean of Westminster, 8vo. 10s. 6d.

The Star in the East, a Sermon delivered in the Parish Church of St James, Bristol, February 26, 1809, for the benefit of the Society of Missions to Africa, and the East; by the Rev. Claudius Buchanan, L. L. D. 1s. 6d.

A Dissertation on the Logos of St John, comprehending the Substance of Sermons, preached before the University of Oxford; by Richard Laurence, L. L. D. rector of Mersham, Kent. 3s.

A Series of Discourses, on the Principles of Religious Beliefs, as connected with Human Happiness and Improvement: by the Rev. R. Morehead, A.M. junior, minister of the Episcopal Church Cowgate, Edinburgh. 8vo. 9s.

A Discourse, preached in the Episcopal Church, Cowgate, Edinburgh, February 9, 1809, being the Day appointed for a General Fast; by Archibald Allison, L. L. B. Prebendary of Sarum. 1s.

A Portraiture of Methodism, being an impartial View of the Rise, Progress, and Manners of the Wesleyan Methodists; by Joseph Nightingale, 8vo. 10s.

A Sermon preached at the Assizes, held at Winchester, March 8th 1809; by the Rev. C. J. Gough Seare, L.L.B.

Sermons preached before the University of Oxford, in the year 1806, at the Bampton Lectures; by John Browne, M. A. late fellow of C.C.C. 8vo. 9s.

Discourses on the Genuineness, Integrity, and Public Version of the New Testament by Lant Carpenter, L.L.D. 1s. 6d.

Errors respecting Unitarianism considered, &c. &c. A Discourse by Lant Carpenter, L.L.D. 1s.

The Nature, Origin, and Effect of the Creation by Jesus Christ considered, in a discourse by the Rev. Russel Scott.

The History of the Church of Christ; by the Rev. Isaac Milner, D.D. Vol. IV. Part 2, 8vo. 10s.

Sermons, chiefly designed to enforce Christian Morality; by the Rev. Thos. Gisborne, M. A. 8vo. 8s.

A connected History of the Life and Divine Mission of Jesus Christ, as recorded in the Narratives of the Four Evangelists, with Notes, selected from the short hand papers of the late Rev. Newcombe Cappe; by Catherine Cappe 8vo. 12s.

Practical Sermons; by Abraham Rees, D.D. 2 vols. 8vo. 1l. 1s.

Sermons, Controversial and Practical, with Reflections and Tracts on interesting Subjects (heretofore published in Iteland only;) by the late Rev. Philip Skelton, Rector of Rintora, &c. &c. Re-published by the Rev. Samuel Clapham, M. A. 8vo. 9s.

The New Testament, in an improved Version, upon the basis of Archbishop Newcombe's New Translation, with a corrected Text, and Notes Critical and explanatory. Published by the Society for promoting Christian Knowledge, Royal 8vo. fine paper, with Maps, 16s. —Royal 12mo. with Maps, 8s.—Demy 18mo. 4s.

A Sermon on the Prevailing Corruptions of the Age, preached in the Parish Church of Fulham; by the Rev. W. Pochett. 1s.

The Necessity of Religion and Virtue to National Happiness and Prosperity, a Sermon preached at the Scotch Church, Woolwich, on the General Fast, Feb. 8, 1809; by the Rev. Wm. Vessie, A.M

27.9.10 Trade

PATENT OFFICE LIBRARY

PATENT OFFICE